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ABSTRACT

School administrators, teachers, and businessmen will find this work-study guide useful in developing courses to teach the disadvantaged to be operators of automatic data processing equipment. Fourteen course units cover fundamental principles of programing, specific programs such as FORTRAN and COBOL, and the skills required for the position. Each unit outlines training time, objectives, and the basic course material, and includes when available teaching aids, instructor reference materials and suggested trainee activities and materials. Sections of the guide are devoted to sources of visual aids, occupational information, trainee qualifications, and suggestions for course organization and operation. A glossary and a bibliography are included. Appended are suggested equipment and supply lists and a training facility plan, and sample forms and records. (JS)

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COMPUTER SYSTEMS
OPERATOR

A Suggested Instructor's Guide

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Manpower Development and Training Program

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FOREWORD

After the end of World War II there occurred a population, technological, and information explosion bringing about continuing and relentless pressures. Each has resulted in its benefits and attendant problems and offers great potential for new solutions.

The deluge of forms, reports, and statistics caused by the information explosion has resulted in the growing science or art of data processing. The only tool capable of containing and directing the impact of the huge mass of data now available is the use of the electronic computer. As with all new technologies, this one, also, demands craftsmen skilled in the use of the equipment designed to meet its demands. New and rapidly growing jobs, both professional and skilled, geared to programming and operating the electronic computers have come into being.

In earlier years of this emerging field, the emphasis in selecting trainees was directed toward the college graduates with a background in mathematics and science. As the field of electronic computers developed, however, it became apparent that this level of background training was not necessary for operators. Other more basic abilities were identified as necessary for success. The rapid increase in the number of computers and the urgent need for capable operators hastened the change.

Experience in the last several years has indicated that the educationally and culturally disadvantaged segments of the population can provide a significant number of persons with both the aptitude and motivation needed to succeed as operators. The move from the ranks of the disadvantaged to that of gainful employment is not easy, but the rewards are significant and worthwhile for both the individual and our society.

This instructor's guide was prepared to assist in developing courses and instructing disadvantaged trainees in a new and needed skill through programs under the Manpower Development and Training Act and other related programs.

Howard A. Matthews, Director
Division of Manpower Development
and Training

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COMPUTER SYSTEMS
OPERATOR

PURPOSE OF THE GUIDE

This course guide offers assistance to those who wish to establish a cooperative occupational training program for operators of automatic data processing equipment.

It is especially geared to show how educationally disadvantaged persons can be trained for jobs in the data processing field under the Manpower Development and Training Act and other types of occupational training programs. The guide is directed both to the administrators of such training projects and to the instructors who will handle the classroom and laboratory work, coordinate the cooperative work experience with employers, and generally maintain the direct contact with the trainees.

The training program may be set up within the framework of vocational education offered by an already existing training institution, such as the public school system, or by a new institution. In any case, the direct involvement of government, business and industry must be enlisted early in the development of plans to insure that the facilities available for training will be adequate, and that there will be jobs for the trainees at the end of the course.

While the training program outlined in the guide assumes that the trainees will be educationally disadvantaged, those preparing to put the program into operation must be cautioned to exercise special care in trainee selection, as outlined in the TRAINEE QUALIFICATIONS, page 6. The computer industry is a demanding one. Job requirements vary widely, from the sole operator of a small computer installation with punched card support equipment, to the operator of a large computer system engaged in teleprocessing. Formal education aside, the industry still requires certain basic aptitudes from its operators. Modern data processing equipment represents a substantial investment, and errors and breakdowns in the equipment caused by a lack of basic ability on the part of the operator cannot be overlooked. Such mistakes are costly. To put a person without the requisite ability through the training is a disservice to the individual. Administrators developing a program for the disadvantaged, therefore, should be conservative in their attempts to recruit into the computer operator training program those persons who may not have the necessary aptitudes.

In addition to being a specific guide for preparing educationally disadvantaged for the automation work force, this guide should be generally useful to the burgeoning computer field and its continuing demand for all levels of trained personnel. The course should devote less time to Units XIII, Communications Skills, and XIV, Mathematics Skills, in programs where the trainees have stronger educational backgrounds, and place less emphasis on Units X, Data Processing Organization and Management, and XI, Job Orientation, Guidance, Counseling, and Evaluation. Coverage of

Unit IX, Advanced Systems, might be expanded. Otherwise, the content of the course is general enough to serve a wide range of educational backgrounds. Similarly the unit outlines, while written for specific equipment are general enough to cover similar equipment of other manufacturers.

OCCUPATIONAL INFORMATION

It should be noted that this guide was compiled shortly after the introduction of the "third generation" of computers. These characteristically employ miniature and integrated circuits in their construction. But, of the "second generation" (transistorized computers) and the third generation, computer manufacturers provided more software packages and programs on standard design which aid the user in exploiting the computer. It is important that the operator be as familiar with this standard software as he is with the buttons and switches on the console which represent the bulk of his contact with the hardware.

In the development of the larger machines, there has been substantial progress in "diagnostics". These are programs and program elements which diagnose computer ills and inform the operator as to what he should do to correct them. If the proper action for an operator can be prescribed, then frequently the computer itself can take the necessary action without the intervention of the operator. He may not even be informed that the computer found and solved its own problem. The larger machines usually require operator intervention only when a judgement is required, when a choice involving managerial policy must be made, or when something unforeseen occurs.

The operator is therefore under pressure to react quickly and in the correct manner based on his knowledge of the equipment, the software package, the program which is being run, the formats of inputs and outputs, special instructions from the programmer, and the policy of the installation supervisor toward handling error conditions. Operator errors or misjudgments can quite easily cost thousands of dollars per hour of lost machine productivity. This may occur simply because the operator failed to make careful note of the conditions prevailing at the time of the error.

Due to the ever-changing nature of the industry, moreover, the habits, responses, and skills of an operator cannot remain static. New software and hardware modifications make it urgent for the operator to alter old skills and to acquire new ones. If a task is simple and procedural, for example, it is likely that it will be taken away from the operator and assigned to the computer programs which monitor the high speed operations of the equipment.

It is, therefore, incumbent that everyone involved in the training program fully understand that the subject matter in the course must be continuously adapted to the industry's changing demands on its personnel. The computer operator-trainee must understand that his new field will require him constantly to improve himself simply in order to maintain his usefulness and earning potential. Automatic data processing is an occupational environment in which industriousness, intelligence, and absolute accuracy are rewarded, and in which the measure of this perfection is the computer more than another human being.

JOB DESCRIPTION

The Dictionary of Occupational Titles, edition of 1965, shows the occupational code as 213.382 under a primary title of Digital Computer Operator.

NOTE: The following descriptive material is modified from that in the Dictionary of Occupational Titles so as to reflect advances in the industry between 1965 and 1968.

Occupational Titles

Graduates of this and similar training programs may expect to find employment in jobs titled as follows: Digital Computer Operators; Computer Operator; Console Operator; Computer-Peripheral-Equipment Operator; Assistant Console Operator; Tape Handler; Tape Librarian.

Duties

A digital computer operator monitors and controls an electronic digital computer from the main console in order to process business, scientific, engineering, or other data, given precise instructions for operating the computer; some instructions vary from task to task. Major activities which an operator performs include the following: sets control switches on the computer and on peripheral equipment such as external memory, data communicating, synchronizing, input and output recording, or display devices in accordance with the directions for processing a task; selects and loads input and output units with materials such as magnetic or paper tapes, punchcards, and printout forms for operating runs; may supervise operators of peripheral equipment who perform these functions.

Also places the equipment in operation through appropriate control switches; clears the equipment, observes the operation of the machines and the control panel of the computer console for error lights, and monitors the main printer and console printer for verification printouts and error messages; observes for machine stoppages and faulty output. When trouble has been observed, follows written, predetermined instructions to correct the error or failure and to resume operations; notifies his supervisor of such errors and stoppages and when the predetermined instructions do not clear the difficulty, obtains assistance from the supervisor.

At the end of operating runs, clears the unit and unloads the peripheral equipment in accordance with instructions associated with the task; records operating and down time; reviews the schedule, and determines the next task to be processed. Operates wire control panels of peripheral equipment; and controls the computer to provide input or output service for another computer under instructions from the operator of that unit.

These positions may also be known as computer operators or console operators at some installations.

An assistant console operator, tape handler, or peripheral equipment operator performs the following: operates on-line and off-line peripheral machines, according to instructions, to transfer data from one recording form to another, print output and read data into and out of the digital computer; mounts and positions materials such as reels of magnetic or paper tape onto spindles, decks of cards in hoppers, bank checks in magnetic ink reader-sorters, notices in optical scanners, or output forms and carriage tape in printing devices; sets guides, keys, and switches according to verbal instructions from the console operator or according to the run book, to prepare equipment for operation; selects specified wired control panels or wires panels in accordance with diagrams and inserts them into machine; controls the switches to start off-line machines such as card to tape converters, or to interconnect on-line equipment such as tape or card computer input and output devices, and high speed printers or other output recorders; inspects materials for creases, tears, or printing defects and watches machines and error lights to detect machine malfunctions; removes faulty materials, and notifies supervisor (possibly the main console operator) of machine stoppage or error; loads card input and output hopper, labels and places cards in boxes, and stores them or routes them to the library; and labels tape spools, places them in protective containers, stores them, or routes them to the library.

A tape librarian maintains a catalog of all tapes in the library indicating tape number and location, originator of the tape and originator's designations, location of pertinent data on the originating run, formats, operating system model and conditions, and so forth; accounts for tapes signed out and returned, noting any modifications to the tape resulting from the run; periodically reviews tape holdings, and determines which, in accorddance with installation rules, should be erased; obtains clearance from tape originator or maintainer, erases the tape, and appropriately alters records; reviews tapes periodically and on schedule and may duplicate them to prevent deterioration and loss of the content; and periodically cleans tapes.

Computer-peripheral-equipment operator as well as the other titles require that incumbent operate the decollator to separate printer output forms, sort them, and prepare them for distribution; and operate punchcard tabulating machines, sorters, collators, and reproducing equipment including special optical reproducers and printers.

EMPLOYMENT OPPORTUNITIES

The computer industry is a rapidly expanding one and for every computer installation there must be at least one fully-trained operator on duty whenever the computer is in use. In the larger facilities, in addition to the operator of the main computer, there may be assistant operators aiding in mounting and demounting the tapes and disk packs as processing tasks are set up or completed, and there will also be operators for the supporting punchcard equipment.

The larger computer installations have shown a tendency to grow in size, often absorbing smaller installations. These large computer facilities may be servants of a single corporation, or they may be located in a computer service bureau which offers services to the public market. They usually employ a number of operators and frequently function on a sixteen or twenty-four hour schedule. The trainee should be made aware that there are special opportunities for advancement as operators and later as supervisors of late shift and weekend schedules. Smaller installations will frequently have only a single operator who is charged with the total administration of the computer facility. The beginner is more likely to find his initial employment in one of the larger facilities, be it governmental, industrial, commercial, or educational.

Because of the rapid changes in the computer industry, there is a continual need for employees to learn and prepare for new challenges. New openings occur at the top levels, providing opportunity for advancement. One advancement pattern for operators leads to the management of computer facilities. Another leads to the ranks of computer programmers with potential growth into systems work. Whichever route the beginning computer operator follows, however, he must prepare himself for advancement by continuous personal improvement.

One of the significant characteristics of the computer industry is that it permeates and supports all branches of commerce, industry, and government. Computers find application in manufacturing, in process control and coordination, in planning, and in management. They are used in all administrative fields, from personnel and financial management to inventory control. They are becoming standard in most large educational institutions. The larger commercial institutions own or lease their own computers, and the smaller ones use the facilities of service bureaus. The market has become active enough to support firms whose sole business is brokering time for owners of computers which do not use their entire capacity. The demand for both computers and computer services is continuously expanding, and there appears no prospect of reduction in demand.

While this growth bodes well for computer operator jobs, it must be borne in mind that the bulk of the jobs are on small computers. For example, there are roughly fifty to one hundred times more small computers than there are large ones. If this trend continues, job opportunities will tend to expand for operators who can handle small, especially card-based computers, without additional staff support, that is, who can do some simple programming tasks.

The computer installations with large machines will provide a number of entry-level jobs for handlers of peripheral equipment and utility individuals who can assist in maintaining the tape and disk libraries and in expediting computer operations. They will also provide opportunities for advancement into supervisory jobs on second and third shift and on weekend operations. These are less likely to be the periods supporting the costly time-shared operations and more likely to be devoted to clearing up backlogs of background processing. The actual operators of large machines, especially main shift operators who oversee remote time-shared operation, will tend to be restricted to experienced individuals who have the best and longest job histories. In these larger installations, there will be greater opportunity for promotion within the organization, whereas in small installations, the advancement opportunities will tend to be restricted to pay increases. These advances will be awarded as the operator makes himself more useful to larger portions of the organization, possibly as an in-house consultant on the application of data processing techniques to the solution of company problems.

SECURITY REQUIREMENTS

Computer operators occupy positions of trust because the information they handle is usually quite important.

This information may represent the record of someone's life savings, national or industrial secrets, or prized and guarded information about the state of a company, a business, or a trade. It is easy, obviously, for a trained operator to copy information of any sort, including copying programs. Writing programs and compiling information is in itself expensive and slow. Even mailing lists have become highly saleable.

At the local level of government, the information may represent extracts from a data bank detailing land ownership, land use and prices. It may, for example, indicate future plans for freeways, and this information, if released, could cause land prices to skyrocket. Such information makes fortunes in real estate transactions. With the price of land varying from a few dollars to several hundreds of dollars per square foot in a city, the rewards for secretly helping someone amass a fortune could present an almost irresistable temptation.

Similarly, the release of information handled in government installations could constitute a serious breach of security.

The computer operator, therefore, stands as a guardian of privacy and of the law. The legal and business implications of data security on organizational, personal, and political history have yet to be fully explored. Candidates for computer operator trainee, however, should be aware of likely developments. Whether the operator trainee later applies for a job with an agency such as the Central Intelligence Agency or a local bank, he is likely to be subjected to a thorough background investigation.

TRAINEE QUALIFICATIONS

While this guide is designed to assist in organizing a program which will aid the educationally disadvantaged to enter the main stream of the economy, only a limited number who possess the required qualifications can hope to be successful in the field.

AGE

Computer system operation offers employment opportunities to persons within a wide age range. A minimum age of eighteen is suggested, to provide maximum opportunity for trainees to complete high school within the normal educational framework. Upper limits on age need be imposed only as physical condition may be affected, or as local hiring situations dictate.

EDUCATION

One assumption underlying this course is that the applicants may not have passed the tenth grade level in educational achievement. Lack of national standards for intermediate education make it difficult to define this level exactly. While the course includes extensive remedial reading work, the trainee will be required to read assigned material after just a very few days. If he cannot read at all, but otherwise has the requisite capacity and qualifications, he should be made first to bring his reading skills up to an acceptable level before commencing the course. This acceptable level implies the ability to understand the IBM Operator's Guide, not including the technical terms which he will be taught, but the basic grammar, syntax, and general vocabulary. It is important that the trainee have mathematical capacity, if not skills. If his mathematical skills are below the tenth grade level, they can be remedied during the course, if he has the requisite intelligence and the willingness to apply himself. By the time the trainee completes the course and actually enters a job in a computer installation, he should have achieved high school equivalency at the least, since the bulk of his professional contacts in a large installation will be with college-level programmers, or with managerial personnel if he is the sole operator in a small installation.

While the trainee may be educationally disadvantaged, this disadvantage must not have stemmed from a basic lack of intelligence. Standardized tests, administered during the selection process, can serve to indicate such problems, and used as diagnostic tools, may be helful in planning a basic education and remedial program tailored to the needs of the trainee. Among the tests which may be used are the Wechsler Adult Intelligence Scale, the Stanford Achievement Test (Adult Version), and the General Aptitude Test Battery devised by the United States Employment Service. The most promising candidates for training should be those scoring in the normal to bright normal ranges, and show overall achievement of approximately the tenth grade level. However, since the tests can give an only rough approximation of abilities, they must be used as only one of many criteria for selection.

Tests of aptitude for computer operation technical training may likewise be used as rough measures of potential, among many other related factors. Those which have attained resonable standardization are the IBM Aptitude Test for Programmer Personnel, and the Lowry-Lucier Reasoning Tests A and B. Scores lower than those suggested as cut-offs for programmer personnel should be considered as showing good potential for computer operations. Aptitude scores below 28 or reasoning scores below 20 are indications that applicants should be screened more carefully for compensating factors such as high motivation. Such scores may also simply reflect the inability to achieve well on tests due to emotional strain.

PHYSICAL REQUIREMENTS

Computer system operators must perform certain physical tasks, and consequently, must have certain minimal physical abilities. In general operators must have good vision and hearing, and the use of both hands. Full mobility may not be necessary. An operator confined to a wheel chair might have difficulty in changing magnetic tapes, but could perform easily at the console.

Loss of one hand or one arm can be compensated for, allowing satisfactory performance, but such cases should be determined on an individual basis. Prosthetic devices can enable even severely handicapped to perform in a satisfactory manner.

Reduced vision may permit limited functioning at the computer console, but total blindness will, in all likelihood eliminate a trainee candidate.

PERSONAL QUALITIES

Future security requirements suggest that applicants exhibiting emotional stability and strong moral character will have the best chances for success.

Equally important to successful completion of the training is strong motivation to enter and progress in the field of data processing. The trainee must sustain his interest and willingness to work toward his goal from the beginning of the course to the end. While the primary responsibility for this sustained motivation lies with the trainee, the institution can help by a variety of devices such as introducing successful operators and potential future employers; showing films of current developments; field trips to operating installations which differ significantly from those in the area, and so forth.

The trainee will be embarking on a career which is regarded as having professional status. Generally speaking, the computer operator must dress and conform to the business practices consistent with this professionalism. During the period of training, he should reinforce or acquire habits of neatness, promptness, industry, and courtesy, Particular stress must be given to stengthening attention to detail and elimination of carelessness. Trainees who fail to show this attention to detail and exactness should receive special help to draw their attention to the demands and assistance in developing these qualities.

ORGANIZATION AND OPERATION OF THE COURSE

STAFF QUALIFICATIONS

There are four main skills required of the instructional staff: computer technology, remedial English, remedial mathematics, and job counseling and guidance.

There is a requirement for at least two computer specialists with familiarity with different equipments. The remedial English and mathematics instructors, both of whom could be employed part time, should be oriented toward adult education.

Similarly, the guidance counselor should have experience with the age, racial, and economic groups enrolled, as well as with their educational level. He may be a counselor in the local school system or in a local social agency employed on a part time basis. The guidance counselor should have access to a consulting psychologist employed either in related personnel work or in private therapeutic practice.

The computer techniques instructors should be fully qualified on the machines which they are to present and should have had supervisory experience in computer operations. If possible, prior teaching experience would be a valuable asset. Teaching experience in the military, especially in data processing, would represent excellent preparation.

The specific academic qualifications of the instructional staff, while important, are less critical than attitude and experience in dealing with the trainees as people from a disadvantaged background, as long as they can meet minimum state certification standards. Instructors must be aware that they serve as models for their trainees. Therefore, what they say may sometimes be of less consequence than how they conduct themselves.

Periodic supervision and evaluation of instruction by the administration will assure an effective training program.

TRAINING FACILITY CONSIDERATIONS

The organization of the course calls for two general types of activity: classroom and laboratory. The classroom can be a standard arrangement either in an educational building or improvised. The trainees will need four to six square feet of writing space each, so that seats with writing arms will not be satisfactory. Either individual or group tables and chairs can be used. The classroom space will require a large chalkboard area and projection equipment. Space for the storage of wiring panels and connection wires, together with a cabinet which will accommodate 80-column manuscript pads and related supplies will also be needed. A suggested listing of equipment and supplies is contained in Appendix A.

In addition to the classroom area, at least three private offices will be needed for the administrator, the guidance counselor, and the instructors, plus secretarial space and storage. As a planning guide to the space requirements, allow 150 to 200 square feet for each office, an equivalent amount for storage and approximately 200 square feet for secretarial (and possibly reception) area. A classroom should provide approximately 30 square feet per trainee (See Appendix B). Local codes will specify lighting requirements, sanitation facilities, accessibility, and so forth. Consideration of the trainee population will probably dictate that the location be accessible by public transportation or that there be low-cost parking facilities.

Laboratory facilities must be acquired for each of the machines on which instruction will be given. Most desirable, of course, would be the acquisition of the necessary EAM equipment and computers for a laboratory incorporated into the training facility. In almost all instances, however, the cost of such a facility will preclude establishing this arrangement. Equipment leasing costs, installation and removal of specific machines escalates costs rapidly.

Rental of the needed facilities from service bureaus and companies in the immediate area provides a much more feasible solution. The only time paid for is time actually used, and when one phase of training is ended, the equipment no longer being used does not constitute an overhead burden.

In selecting the rental laboratory facilities, the administrator or instructor must consider how the laboratory instruction can be performed in the available space. Since the laboratory work assumes that the instructor and trainees will actually operate equipment, it is essential that equipment availability schedules be firm. It is likely that the equipment can be made available only in the evening, in the early morning, or weekends during off-shift periods, and before or after scheduled maintenance periods. Either the entire group should be accommodated at once or sufficient facilities and instructors must be available to operate separate shifts. It may even be necessary to function in more than one location. The administrator should also consider scheduling laboratory sessions on holidays when the installations are likely to be available. If it is possible to obtain classroom facilities in close proximity to a room equipped with either electric accounting machines and keypunches or with one of the computers related to the course, this would be advantageous. If not, arrangements must be made to transport the trainees to the equipment site.

THE ADVISORY COMMITTEE

The administrator of the computer systems operator course will find it essential to enlist the services of an Advisory Committee. Principal functions of this committee will be: (1) to provide assistance to the administrator during the planning phase, particularly concerning the local job market; (2) to enlist the cooperation of local government agencies, commerce, and industry in providing laboratory facilities, cooperative work experience openings, and instructors; and (3) to aid in the placement of graduates of the course. Appropriate sources of members include the upper executive levels of local institutions, major employers, leading banks, and other financial institutions, public utilities, major retailers, trade associations, central labor organizations, and professional associations both of personnel officers and of data processors, especially the local chapter of the Association for Computing Machinery.

Members of the Committee can be useful in a number of other ways. Their influence and prestige will be of great help in obtaining introductions and enlisting the cooperation of the community and its resources. Stationery and other printed material bearing their names may help.

The technical knowledge of the Committee should be utilized during the planning phases before any recruiting is done, to assure that the training course will prepare the trainees for actual jobs. Periodic reviews during the course should be undertaken to determine whether modifications are needed to meet this goal.

All local employers can be canvassed to ascertain exactly what equipment is in use and what orders have been placed for new machines. It is particularly important to the administrator to know for the various computers in use in his area what operating packages (software) are employed, whether they are the standard manufacturer's software packages, or are special program packages procured either from one of the many computer programming firms or maintained by the employer's own staff. (In the laboratory sessions it is not advisable to experiment with operating packages other than the ones currently in use in the installations providing the laboratory facility. If two employers are using the same machines but different operating systems, they will appear to the operator to be two different computers.) If the employer using the non-standard package can be prevailed upon to cooperate, it may be possible to make special arrangements with him for instruction on his computer and operating system during some of the classroom work as well as during laboratory sessions.

The Committee will also represent the best source of cooperative work experience positions, either through their own companies or through others with which they maintain contacts. In addition these same contacts will allow them to recommend, and insure participation of, speakers who will benefit the trainees during coverage of Unit X, Data Processing Organization and Management, and Unit XI, Job Orientation, Guidance, Counseling and Evaluation.

The Advisory Committee should be called together at periodic intervals for short meetings to reinforce their sense of participation. The administrator of the program can also consult with members individually or in small groups as the need arises. Care should be taken not to divulge confidences, since much of the information needed by the administrator would reveal future corporate plans and therefore be extremely sensitive. Where difficulties arise with some of the cooperating institutions, the Advisory Committee members may be of considerable assistance in cutting red tape and resolving the problem. The Advisory Committee will be particularly useful in structuring and assisting the graduate placement effort.

TEACHING THE COURSE

The administrator should plan the course to balance daily classroom theory and hands-on practice in order to develop and sustain interest. This is most important during the first weeks, before the cooperative work experience commences. It is also especially important in Unit II, Fundamentals of Computer Operations, which has no laboratory work scheduled and which falls in the third week of instruction, to find a substitute for actual hands-on practice. It is suggested that a selection of films, of which the computer industry has produced many, be employed to relieve the monotony of classroom work. Other visual aids and field trips provide additional alternatives.

One copy of each of the manufacturer's manuals referenced under the heading of Suggested Trainee Activities and Suggested Text Assignments should be issued to each trainee. They have not been consolidated into an overall list, since the machine configurations available for teaching purposes will vary widely, and will dictate the choice of manuals to be used.

Instructors should have sufficient material available to permit additional assignments to quicker learning trainees. It is not impossible to conceive of four or five levels of instructional readiness and learning ability being present even within a small group. Each trainee can be working in whatever depth and state of advancement within the subject area his personal abilities permit.

The structure of the course assumes that trainees will be required to do some daily homework and at least one substantial long-term project. It may be necessary to arrange for classroom study periods each day, or each week, to allow for less structured activity and to distribute the lecture periods more comfortably over the day. Break periods of five to ten minutes during the course should be scheduled on an hourly basis.

Supplementary handout materials prepared by the instructors can often clarify and enlarge on presentations from the texts. (Examples are provided in Appendix C.) Various exhibitor handouts may also prove helpful. Most manufacturers are generous in providing such literature. These include announcements of new equipment, reports of data processing developments within the local area and industry news letters in general. Selectively presented, the material will assist in providing trainees with a feeling of involvement with the profesion they are about to join.

In presenting the non-technical material (Communications and Mathematics Skills) the coordinators and instructors are likely to find their greatest challenges. While the material is more familiar to the trainee, he may have a negative attitude toward it left over from earlier school experiences. As a result he may see little or no value to the material. Only by directly linking the content to the technical portions of the course can the instructor overcome these influences. English assignments should cover development and presentation of a job-oriented data processing problem or report. Mathematics assignments on percentates, fractions, and so forth, can be tied to computer problems. Interest and eagerness to learn new technical skills should thus be used to foster the trainee's need to master more basic general learning.

Daily attendance records are important, as is a continuous record of the trainee's performance on quizzes, major examinations, and in daily participation. Subsequent employers express a great deal of interest in all areas of performance by the trainees and will generally request from the school verifications and appraisals of prospective employees. Trainees themselves should be advised periodically of their progress. This could be covered appropriately in one of the counseling sessions.

In establishing training regulations, thought should be given to the special needs of trainees. They are being oriented toward a work atmosphere. Therefore, adherence to schedules and maintenance of decorum, including acceptable personal appearance, assumes special importance. This will assist trainees to move from the classroom to the cooperative occupational training environment and thence into full time employment.

MANAGING THE WORK EXPERIENCE PROGRAM

The cooperative work experience phase of the course runs from the fifth to the twentieth weeks of the course. This concept envisions that the trainee will become a paid employee of the cooperating computer installation during this period and spend half-days every other day working in that installation. Hourly rates consistent with his contribution to the work of the installation provide added incentives to the trainee to learn and advance.

A trainee will work directly under a supervisor who will expect him to perform assigned tasks and fit into an existing production organization. The supervisor should try to give him tasks which are closely related to the trainee's developing skills. During the twenty-first through twenty-fifth weeks, the trainee will spend half-days every day on his job. During the twenty-fourth and twenty-fifth weeks, Unit X, Data Processing Organization and Management, will formally consolidate the trainee's knowledge and experience. During the last week, a portion of Unit XI, Job Orientation, Guidance, Counseling, and Evaluation, will give the individual trainee intensive attention, readying him for his permanent job. Hopefully the trainee will move from a part-time to full time status with the cooperating installation based on his work record and knowledge of that operation, although this may not always be possible.

The success of any cooperative work experience program depends on successful cooperation between the training installation and the organization providing employment. In his role as coordinator, the instructor will be able to provide guidance to the supervisor regarding the level of performance to be expected of trainees at particular periods of the course. He will be able to relate classroom and laboratory course work to job assignments and needs, and provide a vital link between these two related aspects of the course. Despite the best intentions, however, problems can arise between the direct supervisor of the trainee and the instructor who is trying to aid the trainee to adjust to the work situation.

The instructor should visit trainees on cooperative work experience assignments. This is advisable for many reasons relating to program development and guidance. It may, however, also contribute to the success of the individual trainee.

There are a number of specific cautions pertinent to such visits. First, the instructor should not enter the cooperating facility without having first cleared with the trainee's job supervisor. Also, the instructor may easily find himself in a destructive role if he becomes a carrier of information between the trainee and the supervisor. Where he senses that such a situation might arise, he should obtain guidance from the staff counselor.

In approaching both the supervisor and the trainee, the instructor should ask questions in the general vein: "What are the major problems or difficulties you are experiencing?" "How are you handling them?" "What are the minor problems you are having?" "How are you handling these?" The trainee should be encouraged to bring these difficulties to the attention of the class during group counseling sessions where they can be analyzed and the underlying difficulties, if any, uncovered. In the course of the group discussions, constructive methods for handling the problems will likely become apparent. The instructor whould take pains not to involve himself directly in the problems. The non-directive guidance approach should be used whenever it is practical to do so.

The instructor must maintain accurate records of the trainee's performance. These records should be available to the trainee's job supervisor. Evaluations by the job supervisor will provide useful guidance to the instructor about the performance of the trainee and the instructor's own success.

PLACEMENT

The major emphasis on the placement of graduates should be through the local offices of the State employment service. Placement activities undertaken by the training institution should complement and be coordinated with the employment service activities.

Successful placement of trainees requires a list of available jobs and their specifications, and a list of graduates of the program and their qualifications. The applicant qualification form should contain the usual information expected by employers, including educational background, the machines of specialization and the levels of proficiency attained.

In supplementing the employment service efforts and developing a list of job requirements, the administrator could use direct mail, forwarding a questionnaire to the personnel directors of all area organizations and institutions which own or lease computers and electronic accounting machines. A covering letter on stationery containing the names of the Advisory Committee will aid significantly in obtaining the attention and cooperation of the personnel directors. The questionnaire should be developed to include projections of need and a census of current employees and employee skills, together with statements about hiring preferences and policies, and acceptable entry levels. Once the letters are out, they should be followed up by telephone contact or in some instances by a personal visit. Personal contacts are time consuming, but often show the best results in developing lasting relationships with employers.

After the questionnaires have been returned, the placement effort becomes a matching of trainees against available jobs, and referral of those qualified for interviews.

The administrator should also develop a form indicating results of the interview which will be returned to him by the personnel director of the interviewing organization. If a graduate is hired, the form provides an excellent record of where and when employed and of starting salary. If the trainee is not hired, the reasons for not hiring can be very informative in helping the trainee to overcome some shortcomings. Collectively these reasons may provide a basis for modification and improvement of specific segments of the training course which are not adequately meeting the needs of employers.

Analysis of these forms, then, should be conducted in two areas: First, by the guidance counselor and the instructor, to assist the individual trainee in his efforts to become more employable; and second, by the administrator, in order to ascertain whether patterns are apparent which would indicate needed changes in the course content or concept. It should be noted that the results obtained through use of these interview forms are meaningful only to the extent that interviewing installations provide factual answers. The establishment of a close personal relationship between the institution and potential employer is one of the best ways to insure such cooperation.

Continuing records of trainee referrals and company responses will further round out the placement profiles of the group. See Appendix D.

The placement service will be able to develop a valuable list of potential employers using its own experience and the aid of the Advisory Committee. A file of each of these potential employers, indicating advertising practice, interview results, and the experience of the program with the employer will become increasingly important to the program as it continues.

GUIDANCE AND COUNSELING

The security requirements which surround most data processing centers preclude hiring persons who would be poor security risks. Generally this will have eliminated the most emotionally disturbed among the disadvantaged from candidacy in the program.

The hurdle from educational disadvantage to employment in a demanding industry assumes a high degree of personal motivation. The guidance and counseling of the computer operator trainees in this program are likely to be fairly conventional. Trainees should be informed of the occupational alternatives open to them after training is completed, and given a realistic picture of the possibilities in these occupations. They should be aided in achieving recognition of their personal capabilities and of the exciting potential of the field into which they are entering. They must understand the behavior and productivity which will be expected of them and the part they may play in any organization which they join.

The trainees must be given a realistic picture of the job demands and responsibilities. They must be made to understand that continuous learning and skill improvement are the best ways to professional advancement, and that they are working in a field in which there is no room for slackers. Trainees should also be encouraged throughout the course in the development of desirable personality traits, in matters of income budgeting, in selecting outside interests that support professional development, and in general good citizenship. Mastering computer skills will do a great deal for the bearing and self-image of the trainees. This is a process that will evolve slowly as training advances.

The guidance counselor will find all types of personality among trainees. Because of their disadvantaged backgrounds, many have built up defensive attitudes. Often, this will take the form of hostility to the authority of the administrator or instructor. The guidance counselor, therefore, should recognize that problems will arise with trainees which he cannot handle. Psychological consultants should be available to the counselor to discuss these problems and methods of handling them.

The primary aim of the counseling program should be the development of proper attitudes and the resolution of significant problems. By assisting trainees to understand their feelings, constructive ways of handling situations which cause them difficulty can often be developed.

Guidance counselors may find it useful to adopt group dynamic methods to further these aims. The counseling groups should be conducted as informal discussions, with the counselor interjecting himself as little as possible, yet guiding the discussion toward key problems such as conflicts with supervisors, personal hostility, attitudes towards self, the job, or the firm or agency, all of which contribute to difficulties in work situations. If possible, counseling groups should not be larger than five or six individuals, though groups of up to fifteen can function.

When discussions are to focus on more general matters, such as job opportunities and trends in the industry, it will be beneficial to bring in appropriate resource persons. Group discussions, in either small or large groups, should be conducted following the presentations. The choice must be left to the discretion of the administrator and the guidance counselor and will depend in part on the time which the guest can devote to such discussions. The administrator may be able to arrange small group discussions with resource people outside the regular training period for trainees who would appear ready to benefit from such sessions. Members of the Advisory Committee are often excellent choices for such sessions and may be more readily available because of their continuing interest in the program.

Resource persons, guests, and operators who represent success stories with which the trainees can identify their own experiences and goals may also lend desirable reinforcement to the course.

The administrator or guidance counselor may also find it useful to bring in additional resources from the community to aid the trainees in general personal orientation. Such persons might be credit union heads, bank representatives, legal aid advisors, consumer educational specialists, or others, depending on community resources.

RECORDS

Training program records are important. If the training program is being sponsored within an established educational or training institution, sample guidelines for record standards, maintenance, and disposition will already be established. If the training course is being conducted only once, a custodial organization for the records should be sought early and clearly identified as such in all records made and distributed because there will be a continuing need for employment references and follow-up after the dissolution of the training program. If the custodial agency is a governmental manpower development agency or the United States Employment Service, guidance on the structuring of records to conform to administrative standards and requirements should also be sought during the initial planning phase.

The major records of the course should include the following for each trainee: a personal history; attendance records; records of grades; tests, and other performance measures; records of evaluation by instructors, guidance counselor, and cooperative work experience job supervisors.

Care should be exercised that all results from counseling and job interviews be treated as confidential material and released only to those with appropriate qualifications and need to know. The right of the individual trainee to privacy must be respected. Otherwise, the trainees will quickly lose confidence, and the effectiveness of the program will be seriously impaired.

When cooperative work experience positions are agreed to by the employer and the training institution, a commonly acceptable evaluation record should be established. The record will indicate to the school and the guidance counselor what progress the trainee makes and what problems arise so that they may be dealt with promptly and effectively.

The training institution records should also include reports detailing counseling sessions with the trainee by the guidance counselor, general results, and any residual problems which may require additional attention. All of this material must be treated as confidential.

The administrator should design an evaluation form which will serve as a transcript of credits to indicate to interested employers what skills and what level of performance the trainee has achieved during the course. These should not take the form of relative grades in the traditional academic sense, but should indicate achievement with some kind of objective measure. The form should record all equipment and software packages on which the trainee has received instruction along with an indication of his performance. An example of an objective performance scale might be the time required to diagnose and correct certain types of malfunction.

The personal history file maintained on each trainee should include name, birth date and place, notation of family name and residence, parent's or guardian's occupation and address, residence records, educational background prior to entering the program, and the history of job interviews and placement. See Appendix D.

In addition, the administrator should maintain comparative records of class performance, records on the cooperation of various institutions in providing cooperative work experience, and employment records.

LENGTH OF COURSE AND COURSE UNITS

The total course is planned to cover a six month period and provides for 1040 hours of scheduled instruction. The work can be divided into three major categories: (1) technical training comprising Units I through IX; (2) introduction to the world of work covered in Units X through XII; and (3) remedial education covered in Units XIII and XIV.

The remedial education in English and mathematics begins at once and continues throughout the course. The introduction to the world of work is actually intermingled throughout the technical training as an introduction to the duties of the computer operator. It also forms a group of special units dealing with organizations. Beginning with the fourth week, the trainee enters Unit XI, Job Orientation, Guidance, Counseling, and Evaluation, and the following week begins Unit XII, Cooperative Work Experience, which continues part time from the fifth to the twentieth weeks.

The technical training progresses gradually. It is assumed at the start that the trainee will have no exposure to activities as abstract as data processing in his prior experiences. While Electronic Accounting Machines are gradually becoming obsolete, and while many authorities are predicting the ultimate demise of the punched card as an input device, this equipment is still widely available and will continue in demand for some years. It still consitutes the best introduction to data processing for trainees who lack extensive education.

The objective of Unit I, in short, is not to make skilled keypunch operators out of the trainees. To achieve such an end, the trainees would have to spend many hours per day in practice during the six month program. The objective is rather to acquaint the trainees with the keypunch machines to the degree essential for an one who must deal with the punch card, and to give the trainee exposure to the equipment which handles punched cards.

The best way to introduce the trainee to the meaning of codes and data and to the problems of sorting, collating, and editing is to require him to perform these operations manually, then with punched cards and equipment, then with computers which operate on punched cards, and finally with the larger stored program computers.

The trainee will advance in Units III and IV to card operated computers. In Unit VI he is introduced to the large computer for which he is being trained. He will acquire his major needed skills on this computer in Units VII and VIII. Three of the technical units provide general education on computers. Unit II, Fundamentals of Computer Operations, provides the trainee with basic understanding of the engineering and programming functions of computers. Unit V, Large Stored Program Computers, deepens his understanding of the history of data processing . It surveys the entire field. Unit XI, Advanced Systems, takes up recent developments, especially remote time sharing of large computers and the beginnings of the "information utility" industry.

SPECIAL NOTE: The schedule makes no provision for holidays. The administrator and instructor staff will have to make the necessary provisions. The administrator is further reminded, however, that holidays, as noted above on pages 9 and 10, like weekends, represent periods when busy computer installations are more likely to be willing to permit the trainees in lzboratory sessions to actually work on the computers.

MASTER SCHEDULE

UNIT NO.	UNIT TITLE	SCHEDULED HOURS PER WEEK																										TO-TALS
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
I	EAM AND PUNCHCARD PRINCIPLES	30	30																									60
II	FUNDAMENTALS OF COMPUTER OPERATIONS			30																								30
III	CARD OPERATIONS				25	21	19																					65
IV	UTILITY APPLICATIONS AND ELEMENTARY PROGRAMMING							25	24	25																		74
V	LARGER STORED PROGRAM COMPUTERS										24	25	24															73
VI	INTRODUCTION TO COMPUTER OF SPECIALIZATION													25	24													49
VII	OPERATING SYSTEMS															25	24	21	18									88
VIII	FORTRAN AND COBOL																			21	18							39
IX	ADVANCED SYSTEMS																					9	10	9				28
X	DATA PROCESSING ORGANIZATION AND MANAGEMENT																								10	9		19
XI	JOB ORIENTATION, GUIDANCE, COUNSELING, AND EVALUATION				5	5	5	1		1		1		1		1		1		1		1		1		1	30	55
XII	COOPERATIVE WORK EXPERIENCE					8	12	8	12	8	12	8	12	8	12	8	12	8	12	8	12	20	20	20	20	20		260
XIII	COMMUNICATIONS SKILLS	5	5	5	5	3	2	3	2	3	2	3	2	3	2	3	2	5	5	5	5	5	5	5	5	5	5	100
XIV	MATHEMATICS SKILLS	5	5	5	5	3	2	3	2	3	2	3	2	3	2	3	2	5	5	5	5	5	5	5	5	5	5	100
	WEEKLY TOTALS	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	1040

Unit I

ELECTRONIC ACCOUNTING MACHINERY AND PUNCHED CARD PRINCIPLES

Training Time Classroom 30 hours; Laboratory 30 hours

Objectives

To orient the trainees in the field of data processing.

To develop the trainee's knowledge and understanding of data forms, data manipulation, and card processing equipment.

To develop rudimentary skills in operating keypunch and verifying equipment to create punched card decks.

To develop the trainees' skills at operating the basic EAM (Electronic Accounting Machinery) equipment to perform the operations of duplicating, sorting, merging, editing, gangpunching, reproducing, and interpreting decks of card

Unit Outline

A. General Introduction
  1. General introduction to information and computation systems
    a. Origin and history
    b. Numerical calculators and mechanical accounting
    c. Electro-mechanical and electronic systems
  2. Applications of EAM and punched cards in the business world and in government
    a. Billing and accounting systems, credit systems, and inventory management
    b. Personnel and administrative systems
    c. Information and document control systems
    d. Production control systems
    e. Correspondance control, advertising, and directory systems
  3. Data representation and coding principles
    a. Names, symbols, and meaning
    b. Coding systems
      (1) Numeric systems
        (a) Binary
        (b) Decimal
        (c) Octal
        (d) Hexadecimal
        (e) Binary-Coded Decimal (BCD)
        (f) Excess-three Binary Coded Decimal (XS-3)
        (g) Gray code
      (2) Alphabetic systems
      (3) Alphanumeric systems
        (a) Teletype (Baudot) code

        (b) EBCDIC (Extended Binary Coded Decimal Interchange Code)
        (c) USASCII (USA Standard Code for Information Interchange)
        (d) Hollerith code (12-place code for 80-column punched cards)
    c. Introduction to classification systems and their coded representations
      (1) Hierarchy systems and formatted files
      (2) Concept-intersect systems (example the Peek-a-Boo system)
  4. Preparation of data, card formats, and design
    a. Types of data systems
      (1) Completed and closed systems, classes of data and coding schemes completely specified in advance
      (2) Open systems in which coding and classification systems must occasionally be modified
    b. Types of punched card data collection devices
      (1) Manuscript forms, note-taking forms
      (2) Punch cards
      (3) Mark-sense cards
      (4) Port-a-punch cards
      (5) Source data automation devices
    c. Code specifications and glossaries
    d. Information structure and layout
      (1) Data items, card fields
      (2) Cards, entry descriptors
      (3) Files
        (a) Master and detail cards
        (b) Common fields
        (c) Variable fields
        (d) Sequence numbers

B. Card Punching (the IBM 024, 026, and 029 Keypunches)
  1. The 80-column card
    a. Description
      (1) Length, width, thickness, storage dimensions
      (2) Hollerith code, 12 positions, 80 columns
      (3) Card face, 12s-edge, 9s-edge, corner cuts
    b. IBM card coding systems
      (1) Numeric
      (2) Alphabetic
      (3) Special character codes
    c. Control punches (usually 11 [X-punch] or 12 [Y-punch])
    d. Card fields
    e. Care and handling of individual cards and decks
  2. Description and nomenclature of the IBM keypunches
    a. Demonstration of machine
      (1) Keyboards
        (a) Numeric keyboard
        (b) Alphabetic keyboard
      (2) Functional control switches
        (a) PRINT
        (b) AUTO SKIP/AUTO DUP
        (c) AUTO FEED

- (3) Keyboard control functions
  - (a) ALPH and NUM keys
  - (b) REG key
  - (c) FEED key
  - (d) REL key
  - (e) SKIP and $\underline{\text{SKIP}}$ keys
  - (f) DUP key
  - (g) $\overset{\text{MULT}}{\text{PCH}}$ key
  - (h) Space bar
  - (i) $\overset{\&}{\text{P}}$ (12 zone or Y-punch) key
  - (j) 0/ (zero digit or 10 zone punch) key
- (4) Major components
  - (a) Card hopper
  - (b) Card stacker
  - (c) Punching station
  - (d) Reading station
  - (e) Main line switch
  - (f) Program control lever
  - (g) Back space key
  - (h) Program unit
  - (i) Column indicator
  - (j) Reading board
  - (k) Chip box
  - (l) Fuses
  - (m) Pressure roll release lever

c. Differences among the 024, 026, and 029 Keypunches
- (1) Additional features of the 026 not provided by the 024 Keypunch
  - (a) Printing concurrent with punching
  - (b) Left-zero printing
  - (c) Programmed print suppression
- (2) Additional features of the 029 not provided by the 024 or 026 Keypunches
  - (a) Interpreting
  - (b) Automatic left-zero insertion
  - (c) Error resets
  - (d) X-punching
  - (e) Program select
  - (f) Additional characters
  - (g) Clear switch
  - (h) Two print switches

3. Machine operation
   - a. Program unit
     - (1) Functions
     - (2) Loading
     - (3) Control
   - b. Turn-on procedure
   - c. Demonstrations and exercises
     - (1) Punching individual fields
     - (2) Hand feed and automatic feed of cards

    - (3) Duplicating damaged and erroneous cards
    - (4) Preparing program cards
    - (5) Clearing jammed cards
    - (6) Clearing jammed or locked keyboard
  - d. Preparation of program card
    - (1) Duplication
    - (2) Alpha-numerics
    - (3) Skipping
  - e. Verification
    - (1) Sight checking
    - (2) Machine verification and the 056 and 059 Verifiers
      - (a) Function
      - (b) Major differences from the keypunches
      - (c) Location of the card notch
      - (d) Error light
      - (e) $\genfrac{}{}{0pt}{}{\text{VER}}{\text{DUP}}$ key
      - (f) $\genfrac{}{}{0pt}{}{\text{AUX}}{\text{VER}}$ key
      - (g) $\frac{\text{MP}}{\text{ER}}$ key

C. Sorting (the IBM 082, 083, and 084 Sorters)

- 1. Description and nomenclature of the sorters
  - a. Demonstration of the machine
  - b. Speed characteristics
    - (1) 082 Sorter, 650 cards per minute
    - (2) 083 Sorter, 1000 cards per minute
    - (3) 084 Sorter, 2000 cards per minute
  - c. External features
    - (1) Main line switch
    - (2) Feed hopper
    - (3) Start and stop keys
    - (4) Pockets, designation and order
    - (5) Sorter brush assembly
    - (6) Selection switches and keys
    - (7) Chutes and chute blades
  - d. Operating principles
- 2. Sorting principles
  - a. Numeric sorting
    - (1) Normal sorting
    - (2) Block sorting
  - b. Alphabetic sorting
  - c. Selective sorting
  - d. Sorting short-cuts
  - e. Merging with the sorter
  - f. Special procedures
    - (1) Sorting needle
    - (2) Sorting brush gauge

D. Collating (the IBM 085, 087, and 088 Collators, and alternatively the 077 and 089 Collators)

- 1. Description and nomenclature of the collators
  - a. Demonstration of the machine
  - b. Speed characteristics and model differences

        - c. External features
            - (1) Main line switch
            - (2) Primary and secondary feed hoppers
            - (3) Stackers and designations
            - (4) Control panel compartment door
            - (5) Operating keys and signal lights
        - d. Control panel and mounting
    - 2. Collating functions
        - a. Sequence checking
        - b. Selecting
        - c. Merging
        - d. Matching
    - 3. Control panel wiring and machine operation
        - a. Sequence checking
        - b. Selecting
        - c. Merging
        - d. Matching

- E. Interpreting (the IBM 548, 552, and 557 Interpreters)
    - 1. Description and nomenclature of the Interpreter
        - a. Demonstration of the machine
        - b. Speed characteristics and model differences
        - c. External features
            - (1) Hopper
            - (2) Stacker and selective stackers
            - (3) Control panel
            - (4) Machine controls and indicators
        - d. Machine functions and operation
            - (1) Printing (difference from interpreting with 029 Keypunch)
            - (2) Proving
            - (3) Comparing
            - (4) Selective stacking

Teaching Aids

Punched card chalkboard
Interpreter chalkboard
Keypunch photographs
Verifier photographs
Sorter photographs
Collator photographs
Interpreter photographs

The Cards That Count. Film. International Business Machines Corporation
Mark of Man. Film. Stromberg Carlson Corporation.
EDP For Your Payroll. Film. Bank of America.

Instructor Reference Materials

Reference Manual Operators Guide. International Business Machines Corporation.
Reference Manual, IBM 024-026 Keypunches. International Business Machines Corporation.

Reference Manual, IBM 082, 083, and 084 Sorters. International Business Machines Corporation.
Reference Manual, IBM 557 Interpreter. International Business Machines Corporation.
Automatic Data Processing Glossary. United States Government Printing Office.

Awad, Elias M., and others. Automatic Data Processing Principles and Procedures. Pages 1 through 58 are applicable to section A.

Suggested Trainee Assignments

For Section B trainees should prepare by reading Reference Manual Operators Guide, pages 7 through 29.

For Section C trainees should prepare by reading Reference Manual Operators Guide, pages 30 through 44.

For Section D trainees should prepare by reading Reference Manual Operators Guide, pages 45 through 54.

For Section E trainees should prepare by reading Reference Manual Operators Guide, pages 117 through 127.

Suggested Trainee Activities

If the school policy permits using programmed materials to the maximum during classroom time, a complete course of programmed instruction on EAM is available in the IBM R29 pamphlet series. Three booklets cover each of the equipments: one contains the written text, one is devoted to the illustrations, and one is a combined notebook and set of examinations. For those trainees who finish early and might benefit from additional practice, appropriate exercises can be drawn from the course kit of William E. Bux described next.

If the school budget permits and appropriate facilities are available, each trainee can be issued William E. Bux, Key-Punch Training Course and Kit and Sorter and Tabulator Training Kit. These materials contain both the necessary trainee reading materials and also complete sets of assignments which the trainee can perform. The keypunch materials are designed to achieve professional speed standards. The instructor should guide the trainees in the use of these materials so that they become completely familiar with the operation of the machines, but he should deemphasize building professional speed. The instructor can use the exercises which are arranged for the IBM 402 and 403 Tabulating Machines as the basis of exercises on the UNIVAC 1004 Data Processing System or on the IBM System/360 Model 20 which will be covered during Course Units III and IV.

If the school budget does not permit the purchase of the Bux materials for issue to the trainees, the instructor should improvise appropriate exercises.

Trainee Materials

If the William E. Bux kits are not issued to the trainees, each trainee should be supplied with the following practice materials

100	Blank manila 80-column cards
1	Flowcharting template
1	Flowcharting worksheet pad
10	Card layout forms
10	Multiple layout forms
10	Keypunch instruction sheets
10	Sorter instruction sheets
10	Interpreter control panel diagrams
1	Interpreter control panel (wires as needed)

Unit II

FUNDAMENTALS OF COMPUTER SYSTEM OPERATION

Training Time — Classroom 30 hours

Objectives

To acquaint the trainee with the basic information necessary to his understanding of both stored and wired program computers.

To introduce the trainee to peripheral equipment including card punches and readers, magnetic and paper tape handlers, magnetic drums and disk files, magnetic ink handling equipment, and graphic inputs and display devices.

To develop knowledge of data processing organizations and individual responsibilities.

Unit Outline

A. Elements of Computer Design and Construction
  1. Computer components for information representation
    a. Binary devices
      (1) Switches and circuits
      (2) Passive two-state devices and sensing
      (3) Register and memory arrays
    b. Information transmission arrangements
  2. Active components for arithmetic and logical operations
    a. Comparators
    b. Half-adders
    c. Carry propagation
    d. Shift registers
    e. Multiplication and division with binary numbers and components
    f. Decimal arithmetic with binary components
    g. Logical operations with binary components
  3. Computer system design
    a. Major components
      (1) Memory and address logic
      (2) Arithmetic and logical unit
      (3) Program control unit
      (4) Special facilities
        (a) Index registers
        (b) Indirect addressing
        (c) Memory protection
    b. Auxiliary storage
      (1) Magnetic tapes and tape handlers
      (2) Magnetic drums
      (3) Magnetic disks
      (4) Magnetic cards and strips
      (5) Punched paper tape and cards
    c. Computer system organization

        - (1) Wired program computers
        - (2) Elementary stored program computers
        - (3) Computers with concurrent operations
            - (a) Input/output operations concurrent with logical and arithmetic operations
            - (b) Multiprocessing computers
            - (c) Remote time-sharing computers

4. Operation codes and stored programs
    - a. Variable word length computers
        - (1) Word marks
        - (2) Addresses
        - (3) Operation codes
    - b. Fixed word length computers
        - (1) Three address computers
            - (a) Addresses
            - (b) Operation codes
            - (c) Advantages and disadvantages
        - (2) Two address computers
        - (3) Single address computers
    - c. Data formats
        - (1) Word length and precision
        - (2) Logical vs. numeric data
        - (3) Fixed and floating decimal point representations
        - (4) Numeric representation
            - (a) Binary
            - (b) Octal
            - (c) Hexadecimal
            - (d) Decimal
        - (5) Alphabetic and special codes
    - d. Special features
        - (1) Index registers and table handling
        - (2) Base address registers and program relocation
        - (3) Program interrupt facilities and concurrent operations
        - (4) Memory protection and remote time-sharing

5. Input and output devices
    - a. Input devices
        - (1) Direct entry switches and keys
        - (2) Keyboard devices
        - (3) Card readers
        - (4) Magnetic character readers
        - (5) Optical scanners
        - (6) Graphic entry devices
        - (7) Analog to digital converters
    - b. Output devices
        - (1) Printers, plotters, and typesetters
        - (2) Paper tape and card punches
        - (3) Magnetic tape and disk pack handlers
        - (4) Cathode ray tubes (CRT's)
        - (5) Digital to analog converters and plotters
    - c. Buffers and controllers
    - d. Long distance communications terminals
    - e. Satellite computers

B. Major Computer Components
  1. Computer console
    a. Switches
      (1) Main line switch
      (2) Internally sensed switches
    b. Status lights
      (1) Power sensing lights
      (2) Status lights for peripheral equipment
      (3) Information and internal state sensing lights
        (a) Accumulator and arithmetic registers
        (b) Address registers
        (c) Program status registers
        (d) Index and base address registers
    c. Input/output devices
      (1) Keyboard and printer (typewriter)
      (2) Paper tape reader and punch
      (3) Card reader and punch
      (4) Magnetic tape and disk drives
  2. Main logic and memory
    a. Memory elements
    b. Memory arrays
    c. Access logic
  3. Peripheral equipment
    a. Punched paper tape readers
    b. Paper tape punches
    c. Card readers and punches
    d. Magnetic tape handlers
      (1) Tape reels
      (2) Tape loops, cartridges, and bins
      (3) Tape storage cabinets
    e. Magnetic drum units
    f. Magnetic disk files
    g. Magnetic card handlers
    h. Optical readers
    i. Optical display devices
    j. Printers
    k. Magnetic ink equipment

C. Fundamentals of Computer Operation
  1. Computer system and facility layout and organization
    a. Configuration charts
    b. Physical requirements
      (1) Air conditioning, ducting, false floors
      (2) Electric power requirements
      (3) Magnetic tape and punched card facilities
      (4) Space requirements
    c. Computer installation work flow
      (1) Work order forms
      (2) Principles of job scheduling
        (a) Assembly of materials
        (b) Balancing of work loads
        (c) Sequencing of operations
        (d) Meeting of schedules
      (3) Job preparation
        (a) Requirements analysis

        (b) Materials retrieval (card decks, tapes, etc.)
        (c) Preliminary operations (duplication of card decks, card to tape operations, etc.)
        (d) Preparation of control instructions (switch settings, control card punching, assembling control decks)
        (e) Computer setup
    (4) Job execution
        (a) Following programmer instructions
        (b) Recording status during operation
        (c) Recording status on aborted runs
        (d) Importance of saving results
    (5) Job accounting
    (6) Job disposition and return of materials to storage or to distribution
2. Responsibilities of personnel
    a. Operator responsibilities
    b. Programmer responsibilities
    c. Supervisor responsibilities
3. Tape and card libraries
    a. Storage systems
    b. Accounting and duplication
    c. Privacy and security

Teaching Aids

Digital Computer Techniques - Introduction. Film. United States Navy
Digital Computer Techniques - Binary Numbers. Film. United States Navy
Digital Computer Techniques - Logic Symbology. Film. United States Navy
Digital Computer Techniques - Computer Units. Film. United States Navy
The Information Explosion. Film. Association Instructional Materials.
The Information Machine. Film. International Business Machines Corporation.
An Introduction to Digital Computers. Film. UNIVAC Division of the Sperry-Rand Corporation.
Mark of Man. Film. Stromberg Carlson Corporation.
Principles of Electronic Data Processing. Film. International Business Machines Corporation.
To Hare is Human. Film. UNIVAC Division of the Sperry-Rand Corporation.
A Voice for Mercury. Film. Western Electric Company.

Instructor Reference Materials

Buchholz, Werner (ed.). Planning a Computer System.

Chu, Yaohan. Digital Computer Design Fundamentals.

Gardiner, Martin. "Mathematical Recreations" in the Scientific American:

"Mental calculations"	April 1967	pp. 116-123
"Mental calculations"	May 1967	pp. 136-141
"Ternary numbers"	May 1964	pp. 118-124
"Prime numbers"	March 1964	pp. 120-128
"Factorial numbers"	August 1967	pp. 105-108

"Permutations"	August 1963	pp. 112-119
"Symmetries and reversals	January 1963	pp. 110-116
"Paradoxes"	March 1963	pp. 144-154
"Bouncing ball puzzles"	September 1963	pp. 112-119
"Short problems"	November 1963	pp. 144-155
"Short problems"	June 1964	pp. 114-120
"Short problems"	March 1965	pp. 112-117
"Short problems"	June 1965	pp. 120-124
"Short problems"	February 1966	pp. 112-118

Gregory, Robert H. and Van Horn, Richard L. Automatic Data Processing Systems: Principles and Procedures.

Huskey, Harry D. and Korn, Granino A. Computer Handbook.

Suggested Trainee Assignments

Trainees should read the "Information" issue of Scientific American, September 1966 and especially the following articles:

McCarthy, John.	"Information."	pp. 65-73.
Evans, David C.	"Computer Logic and Memory."	pp. 75-85.
Sutherland, Ivan E.	"Computer Inputs and Outputs."	pp. 86-96.
Lipetz, Ben-Ami.	"Information Storage and Retrieval."	pp. 224-242.

Note to the Instructor

The instructor is advised to employ films early in this unit and frequently in order to ease the trainee's learning of material which is probably quite alien to his experience.

The instructor should attempt to correlate the material being reviewed with the trainees in Unit XIV, Mathematics Skills, (especially the work on arithmetic and number systems) with the principles of operation of computers. Suitable materials can be drawn from Gardiner's "Mathematical Recreations." Many of the arithmetic and logical functions in computers can be presented first to the trainees as puzzles before showing their place in computer operation.

Unit III

CARD OPERATIONS

NOTE: From this point on, the course will diverge as a result of the types of equipment which are locally available. Units III and IV will instruct the trainees either on the UNIVAC 1004 Data Processing System or on one of the card processors of the third generation of equipments. The IBM System/360 Model 20 was chosen as the example. The outline can be used for any of the other comparable equipments.

Training Time

Classroom 30 hours; Laboratory 35 hours

Objectives

To acquaint the trainees with the characteristics of the systems of choice.

To develop the trainees' skills in operating the equipment correctly.

To develop the trainee's abilities to diagnose and correct malfunctions, especially those of a mechanical nature.

To develop in the trainees an appreciation of the care which must be exercised in order to perform a data processing task successfully.

Unit Outline for the UNIVAC 1004 Data Processor

- A. General System Description, Card Processor
  - 1. Major components and functions
    - a. UNIVAC 1004 Card Processor
    - b. Optional card punch
  - 2. Card processor
    - a. Read section
    - b. Processing section
      - (1) Magnetic core storage
      - (2) Addressing
      - (3) Processor machine code
    - c. Printing section
    - d. Control panel and connection panel

- B. System Operations
  - 1. Printer operation
    - a. Form feed control
      - (1) Line spacing
      - (2) Form control tape
      - (3) Loading forms
        - (a) Tractors
        - (b) Print position scale

(c) Form positioning controls, Panel 1 and 2
(d) Display Mask 4

b. Printing mechanism
   (1) Printing control
   (2) Ribbon
   (3) Ribbon feeding mechanism
   (4) Ribbon changing methods
c. Form installation procedure

2. Card reader operation
   a. Input magazine
   b. Loading cards
   c. Card feeding
      (1) Wait station
      (2) Read photo-diodes
      (3) Card transport
      (4) Card stacker
3. Card punching
   a. General functions
   b. Input functions
   c. Card lifting lever
   d. Wait stations 1 and 2
   e. Punching station
   f. Checking station
   g. Feed roll release lever
   h. Card stackers
   i. Chip drawer
   j. Interunit cable
   k. Motor
   l. Power application procedure
   m. Punch control panel
   n. Operating procedures
      (1) Normal procedure
      (2) Clearing an A Jam
      (3) Clearing a B Jam
      (4) Hopper, chip, and stacker indicators and clearing of jams
4. Power application
   a. Installing or changing connection panels
   b. Turn-on procedures

C. Operating Procedure
   1. Job order analysis
   2. Job preparation
   3. Machine set-up
      a. Inserting proper panel
      b. Form installation procedures
      c. Preparation of form control tape and installation
      d. Power application and initializing
      e. Card stacking and loading
      f. Running a job
      g. Punching cards
      h. Clearing malfunctions

D. Trouble-shooting Problems
   1. Test switch panel
   2. Display panel

- a. Mask selection wheeel
- b. Display masks
- c. Display Mask 4 - Operator's display
  - (1) Processor card reader malfunctions
    - (a) HOPPER (1) - Input magazine empty
    - (b) FEED (2) - feed malfunction at wait station
    - (c) RD JAM (3) - malfunctions of read mechanism or of photo-diodes
    - (d) TSP JAM (4) - malfunction of transport mechanism
    - (e) STACKER (5) - Stacker full
  - (2) Form feeding malfunctions
    - (a) FORM (6) - forms exhausted or separated
    - (b) ADV (7) - form advance error
  - (3) PUNCH (8) - card punch malfunctions; compare indicators on card punch
    - (a) AC and DC indicators off
    - (b) INTL - interlock indicator on
    - (c) HOPPER indicator lit
    - (d) STACKER FULL indicator lit
    - (e) FEED A JAM indicator lit
    - (f) FEED B JAM indicator lit
    - (g) STACKER JAM indicator lit
    - (h) CHIPS indicator lit
    - (i) Punch check detected error in hole count
  - (4) Programmed halts
    - (a) HALT (9) - refer to programmer's written instructions or to programmer
    - (b) IND 1 through IND 4 (10-13) - give pointers to diagnostic options open to and chosen by the programmer
  - (5) Auxiliary card reader malfunctions
    - (a) HOPPER (25) - feed hopper empty
    - (b) FEED (26) - card feed malfunction
    - (c) RD JAM (27) - malfunction of feed mechanism
    - (d) WAIT JAM (29) - malfunction of feed to Wait station 2
    - (e) TSP JAM (28) - malfunction of transport mechanism
    - (f) STACKR (5) - same indicator that lights when processor card reader stacker is full
- d. Display Mask 5 - for identification of current program step for STEP 1 through STEP 31
- e. Display Mask 6 - for identification of current program step for STEP 31 through STEP 62 (if machine is so equipped)

E. Auxiliary Equipment

- 1. Magnetic tape units
  - a. Types
  - b. Major features
  - c. Tape transport or transports
  - d. Head unit or units
  - e. Power switches
  - f. Control punch
  - g. Write enabling ring
  - h. Tape markers
  - i. Tape installation
  - j. Two- hour cleaning
  - k. Eight-hour cleaning

2. Read/punch unit
    a. Functions
    b. Card path
    c. Controls and indicators
3. Paper tape reader
    a. Functions and location
    b. Tape loading
    c. Control switches
    d. Malfunctions

F. Practical Exercises
1. Printing from cards
2. Making card to tape conversions
3. Punching cards from magnetic tape
4. Duplicating cards
5. Editing cards
6. Sequence numbering, sequence checking, and sorting cards

Teaching Aids

EDP For Your Payroll. Film. Bank of America.
The UNIVAC 1001 Card Processor. Film. UNIVAC Division of Sperry-Rand Corporation.

Projection materials can be drawn from the UNIVAC manuals

Instructor Reference Material

General Description, UNIVAC 1004 III System. UNIVAC Division of Sperry-Rand Corporation.

Operating Instructions, UNIVAC 1004 Card Processor. UNIVAC Division of Sperry-Rand Corporation.

Card Reader Motor Switch, UNIVAC 1004 System. UNIVAC Division of Sperry-Rand Corporation.

Processor Forms Stacker, UNIVAC 1004 Card Processor. UNIVAC Division of Sperry-Rand Corporation.

Test Switch and Display Panels, UNIVAC 1004 Card Processor. UNIVAC Division of Sperry-Rand Corporation.

Form Control Tape, UNIVAC 1004 Card Processor. UNIVAC Division of Sperry-Rand Corporation.

Operating Instructions, Magnetic Tape Unit UNISERVO C. UNIVAC Division of Sperry-Rand Corporation.

Operating Instructions, Magnetic Tape Unit UNISERVO VI C. UNIVAC Division of Sperry-Rand Corporation.

Suggested Student Activities

Assign to each student as a project either an essay or a scrapbook on the general theme of careers in data processing. The material should be collected and placed in the custody of the individual who will be responsible for Unit XI, Job Orientation, Guidance, Counseling, and Evaluation.

Suggested Text Assignments

The students should be assigned to read as a review the manufacturer's orientation and operation manuals following the classroom presentation. They should be tested for understanding prior to performing the laboratory exercises.

Unit Outline for the IBM System/360 Model 20

A. Hardware System
   1. Major components and functions
      a. IBM 2020 Central Processing Unit
      b. IBM 1442 Card Punch Model 5
      c. IBM 2501 Card Reader Models A1 and A2
      d. IBM 2520 Card Read Punch and Card Punch
      e. IBM 2560 Multi-function Card Machine
      f. IBM 2203 Printer
      g. IBM 1403 Printer Models 2, 7, and N1
   2. Auxiliary components
      a. IBM 2415 Magnetic Tape Drive and Control Unit
      b. IBM 2311 Disk Storage Models 11 and 12
      c. IBM 1419 Magnetic Character Reader
      d. IBM 1259 Magnetic Character Reader
      e. Communications Adapter
      f. IBM 1009 Data Transmission Unit
      g. IBM 7701 and 7702 Magnetic Tape Transmission Terminals
      h. IBM 1013 Card Transmission Terminal
      i. IBM 7710 and 7711 Data Communication Units

B. Basic System
   1. Central Processing Unit
      a. Main storage
      b. General registers
      c. Program Status Word
      d. Console
         (1) Operating keys and indicators
         (2) Modes
            (a) Process
            (b) Address stop
            (c) Instruction stop
            (d) Storage display
            (e) Storage alter
            (f) Register display
            (g) Register alter
            (h) Storage scan
            (i) Storage fill
         (3) Operating conditions
            (a) Process check
            (b) Normal stop
            (c) Programming error stop
   2. Input/output devices
      a. Input/output control
         (1) Data formats
         (2) Condition codes
         (3) Error conditions
         (4) Interruption
      b. Multi-function card machine
         (1) Machine functions and features
            (a) Primary feed
            (b) Secondary feed
            (c) Read station
            (d) Punch station

        - (e) Card stackers
        - (f) Card print
        - (g) Indicator lights
        - (h) Operator controls
    - (2) Operating procedures
        - (a) Intial run in
        - (b) Last card procedure
        - (c) Card transport access
        - (d) Card jam removal
        - (e) Restart procedures
    - (3) Service procedures
        - (a) Ribbon replacement
        - (b) Setting print heads
        - (c) Chip box care
- c. Card readers
    - (1) Machine functions and features
        - (a) Hopper
        - (b) Stacker
        - (c) Card path
        - (d) Lights and indicators
        - (e) Operator controls
    - (2) Operating procedures
        - (a) Initial run in
        - (b) Jam removal and restart
        - (c) Last card
- d. Card read-punches and card punches
    - (1) Machine functions and features
        - (a) Hopper
        - (b) Read path and elements
        - (c) Punch path and elements
        - (d) Stackers
        - (e) Lights and indicators
        - (f) Operator controls
- e. Printer
    - (1) Machine functions and features
        - (a) Major components
        - (b) Print mechanism and method
        - (c) Operator panel
    - (2) Functional controls
        - (a) Stop key
        - (b) Reset key
        - (c) Carriage restore key
        - (d) Carriage space key
        - (e) Carriage stop key
        - (f) Power on light
        - (g) Ready light
        - (h) Sync check light
        - (i) Form check light
        - (j) End of form light
        - (k) Carriage interlock light
    - (3) Internal and mechanical controls
        - (a) Typebar selector switch
        - (b) Carriage detent switch
        - (c) Typebar insertion wheel
        - (d) Carriage release lever

            - (e) Forms advance knob
            - (f) Horizontal alignment knob
            - (g) Platen positioning knob
            - (h) Paper brake
            - (i) Manual clutch knob
        - (4) Carriage control tape
            - (a) Spacing logic and specifications
            - (b) Punching tapes
            - (c) Installing
        - (5) Operating procedures
            - (a) Inserting forms
            - (b) Inserting carriage control tape
            - (c) Replacing ribbons
            - (d) Changing lines to the inch spacing

3. Peripheral storage devices
    - a. Magnetic tape systems
        - (1) Magnetic tapes
            - (a) Dimensions and specifications
            - (b) Data representations
            - (c) Data records and blocks
            - (d) Parity checks
            - (e) Tape markers
            - (f) File protection device
            - (g) Reels
        - (2) Magnetic tape handlers
            - (a) Tape drives
                - Hubs and capstans
                - Read-write heads
                - Vacuum columns
            - (b) Operator lights and rules
            - (c) Operator keys and rules
        - (3) Magnetic tape handling
            - (a) Cleanliness of machine room
            - (b) Tape storage
            - (c) Tape care
                - Damage prevention
                - Irregular winding
                - Wavy edge
                - Warped reel
                - Cleaning tape and containers
                - Inspecting dropped reels
        - (4) Loading procedure
        - (5) Unloading procedure
    - b. Magnetic disk systems
        - (1) Magnetic disks
            - (a) Dimensions and specifications
            - (b) Functional data organization
        - (2) Disk pack handling and labeling
        - (3) Loading and unloading procedure
        - (4) Operator controls and lights

B. Punched Card Utility Programs

1. General introduction
    - a. Functions performed
    - b. General mode of operation

    c. Description of program decks
    d. Function of program control information card (PCIC)
2. Collate program
    a. Review of functions
        (1) Merging without selection
        (2) Merging with selection
        (3) Matching card for card
        (4) Matching group for group
        (5) Matching or merging with detection of duplicates
        (6) Selecting cards within limits
        (7) Selecting zero balance cards
        (8) Selecting first or last card of each group
        (9) Selecting single card groups
        (10) Inserting secondary cards into primary files based on conditions
        (11) Checking for ascending or descending sequence
    b. Collate program control information card
        (1) Printer availability
        (2) Collating sequence
        (3) Diagnostic error indicator
    c. Diagnostic checks
        (1) PCIC diagnostic check
        (2) Specification card diagnostic check
        (3) Sequence card diagnostic check
    d. Operating procedures
        (1) Operating procedure for system with IBM 2501 Card Reader and IBM 2560 Multifunction Card Machine
        (2) Operating procedure for system with only IBM 2560 Multifunction Card Machine
        (3) Halts and messages
        (4) Restart procedures
3. Gangpunch reproduce program
    a. Review of functions
        (1) Simple master card gangpunching
        (2) Interspersed master card gangpunching
        (3) Offset gangpunching
        (4) Count controlled gangpunching
        (5) Sequence numbering during gangpunching
        (6) Selective reproducing
        (7) Interpreting
    b. Gangpunch reproduce program control information card
        (1) Print suppression
        (2) Collating sequence
        (3) Decimal point or comma in editing format
        (4) Primary and secondary file location
        (5) Storage capacity specification
        (6) Diagnostic error specification
        (7) Editing rules
    c. Diagnostic checks
        (1) PCIC diagnostic check
        (2) Specification card diagnostic check
        (3) Sequence card diagnostic check
    d. Operating procedures
        (1) Assembling the operating deck
        (2) Operating procedures when object program will be punched

        - (3) Operating procedures when object program will not be punched
        - (4) Restart procedures
- 4. List summary punch program
    - a. Review of functions
        - (1) Three levels of control
        - (2) Accumulation of totals
        - (3) Accumulation of card counts
        - (4) Printing and summary punching
        - (5) Sequence checking
        - (6) Headings
        - (7) Page overflow
        - (8) Page numbering
        - (9) Editing of printed data
    - b. List summary punch program control information card
        - (1) Print suppression
        - (2) Collating sequence
        - (3) Input/output specifications
        - (4) Storage capacity
        - (5) Editing instructions
        - (6) Error indicators specifications
    - c. Diagnostic checks
        - (1) PCIC diagnostic check
        - (2) Specification card diagnostic check
        - (3) Sequence card diagnostic check
    - d. Operating procedure
        - (1) Assembling operating deck
        - (2) Operating procedures when object program will be punched
        - (3) Operating procedures when object program will not be punched
        - (4) Halts and messages
        - (5) Restart procedures
- 5. Merge sort program
    - a. Review of functions
        - (1) Ascending and descending sorts
        - (2) Advantages over card equipment with large control fields
    - b. Specification card, control fields
    - c. Operating procedures

C. Tape Programming System Operating Procedures

- 1. General information
    - a. Major modes
        - (1) Tape resident system and advantages
        - (2) Card resident system and advantages
    - b. Programs supplied by manufacturer and functions
        - (1) Basic assembler
        - (2) Card resident control program
        - (3) Tape resident control program
        - (4) Service programs
        - (5) TPS report program generator
        - (6) TPS assembler program
        - (7) TPS sort/merge program
        - (8) TPS utility programs
        - (9) Input/output and basic monitor macro definitions
        - (10) Initial program loader (IPL)

        - (11) Basic monitor program
        - (12) Job control program
        - (13) TPS library management programs
    - c. Organization of operator documents
        - (1) Operator instructions
        - (2) Halt diagnostics
        - (3) Restart instruction
- 2. Operating the card resident system
    - a. Preparing special cards
        - (1) Assignment and configuration cards
        - (2) Job and date cards
    - b. Assembling the card decks
    - c. Initiating a card resident system run
    - d. Identifying programmed halts
    - e. Restarting the system

Teaching Aids

Projection materials can be most efficiently obtained by contacting your local IBM representative. The photographic materials in the IBM manuals all list an identification number by which they can be identified and ordered.

The IBM 1404 Printer. Film. International Business Machines Corporation.

Instructor Reference Material

The IBM System/360 Model 20 Systems Reference Library contains all of the required material. All items can be ordered through the local representative of the International Business Machines Corporation.

The following selected volumes are recommended:

Introduction and System Summary.
Functional Characteristics.
Punched-Card Utility Programs Operating Procedures.
Tape Programming System Operating Procedures.
IBM Data Processing Techniques, IBM System/360 Model 20 User's Guide.
2400-Series Magnetic Tape Units and 2816 Switching Unit.
IBM 2203 Printer Component Description.
2520 Card Read-Punch, Model A1, 2520 Card Punch, Models A2 and A3.
IBM 1402 Card Read-Punch.
Component Description and Operating Procedures, IBM 1442 Card Punch Model 5.
IBM 2501 Card Reader, Models A1 and A2, Component Description and Operating Procedures.
IBM 2560 Multi-Function Card Machine Component Description and Operating Procedures.

Additional materials which the instructor will need for general background are included in the following list, also selected from the Systems Reference Library and available from the same source:

Basic Assembler (Card) Operating Procedures.
Report Program Generator for Punched-Card Equipment Operating Procedures.

Suggested Trainee Activities

Assign to each trainee as a project an essay or a scrapbook on the general theme of careers in data processing. The material should be collected and placed in the custody of the guidance counselor or instructor who will be responsible for Unit XI, Job Orientation, Guidance, Counseling, and Evaluation, and can be used to stimulate group discussions.

Suggested Text Assignments

The trainees should be assigned to read the manufacturer's orientation and operation manuals following the classroom presentation as a review. They should be tested for understanding and for the ability to find their ways through the operators manuals in open book tests prior to the laboratory exercises.

Unit IV

UTILITY APPLICATIONS AND ELEMENTARY PROGRAMMING

Training Time Classroom 40 hours; Laboratory 34 hours

Objectives

To teach the trainee enough about programming the system or utilizing existing service and utility program packages so that he can reformat cards, list card decks, store cards on magnetic tapes, perform simple summaries, sequence number decks, duplicate them, and sort and merge decks.

To develop in the trainee sufficient familiarity with the equipment and the process of design and the capabilities of the equipment, that he will have elementary appreciation of data processing systems and services.

To develop in the trainee sufficient competence with the system that he can perform those services expected of an operator on the computer without the assistance of a programmer and that he can effectively support a computer installation without detailed instructions by a supervisor.

Unit Outline for the UNIVAC 1004 Data Processor

- A. Introduction to Programming
  - 1. Processor memory
    - a. Magnetic core storage
    - b. Storage chart, addresses and sequence of access
    - c. Input/output storage
      - (1) Read storage
      - (2) Print storage
      - (3) Punch storage
      - (4) Working storage
    - d. Defining storage areas
  - 2. Elementary flow charting
    - a. Symbols and their functions
    - b. Flow charting conventions
    - c. Examples of flow charts
    - d. Charting errors
  - 3. Connection panel
    - a. General nature and nomenclature of 1004 programming
    - b. Programming means
      - (1) Hubs
        - (a) Receiving
        - (b) Emitting
        - (c) Neutral
      - (2) Wires
    - c. Sequencing
      - (1) Timing cycles and step clock

- (2) Transfers
  - (a) Ascending and descending
  - (b) Types
    - TRANSFER (TRF)
    - ZERO-SUPPRESS WITH ASTERISK FILL (0-*)
    - ZERO-SUPPRESS WITH SPACE FILL (0-Δ)
    - ZONE-DELETE (ZD)
    - ZONE-DELETE WITH SIGN (ZDS)
    - DELETE ZERO BALANCE (D0B)
    - INSERT (IN)
    - SUPERIMPOSE (SI)
- (3) Step output
- (4) Sequence change
- (5) Distributors
- (6) Collectors

4. Basic operations
   - a. Clear core
   - b. Step sequence change
   - c. Start
   - d. Read, print, and execute
   - e. Carriage controls
   - f. Punch operations
   - g. No process rules
5. Arithmetic operations
   - a. Algebraic addition
   - b. Algebraic subtraction
   - c. Absolute addition
   - d. Absolute subtraction
   - e. Negative numbers
   - f. Arithmetic overflow test
   - g. Method of multiplying and dividing
6. Information sensing (A- and B-pulses)
   - a. Address combines
   - b. Address emitter
   - c. Bit emitter
7. Information entry and editing
   - a. Zone delete
   - b. Insert transfer
   - c. Superimpose transfer
   - d. Bit generator
   - e. Zero suppress
   - f. Delete zero balance
   - g. Space generate
   - h. Compress
8. Comparators
   - a. Types of output
     - (1) Numeric comparison
     - (2) Absolute comparison
     - (3) Alphanumeric comparison
     - (4) Sign test
   - b. Control
     - (1) Levels
     - (2) Shunt wiring
9. Selectors
   - a. Related hubs

        - (1) Program select control
        - (2) Program select power
        - (3) Selector pick-up
        - (4) Selectors and poles
      - b. Use and functions
        - (1) Combinations with address combines, address and bit sensing
        - (2) Uses
        - (3) Selector delay variations
          - (a) Inhibit selector delay
          - (b) Test selector delay
        - (4) Cycle variations
          - (a) Cycle clear and cycle hold
          - (b) Hold

- B. Applications Programming
  - 1. General programming conventions
    - a. General recommendations
    - b. Standard wiring conventions
    - c. Specific rules
      - (1) Emitter output
      - (2) Step output
      - (3) Address combines
      - (4) Step sequence change
      - (5) Selectors
      - (6) Comparators
      - (7) Halt
  - 2. Program testing
    - a. Desk checking
      - (1) Flow charting
      - (2) Program chart coding and checking
      - (3) Preparation of test data
      - (4) Tracing
      - (5) Checking connection panel wiring
    - b. Special cautions
      - (1) Cycle problems
        - (a) Failure to advance beyond ICD
        - (b) Failure to advance beyond OCB
        - (c) Failure to advance beyond ICA
      - (2) Advance to an incorrect step
        - (a) Advance along the wrong path
        - (b) Advance to an unrelated step
    - c. Display panel and its use in operation and debugging

- C. Programming Problems and Practice
  - 1. Sequence checking
  - 2. Sequence numbering
  - 3. Reproducing and reformatting cards
  - 4. Listing and summarizing
  - 5. Gangpunching
  - 6. Sorting and merging

Teaching Aids

Projection materials can be selected from among the illustrations in the UNIVAC manuals listed below.

Instructor Reference Materials

Reference Manual, UNIVAC 1004 Card Processor, 80 Column. UNIVAC Division of the Sperry-Rand Corporation.

Program Testing, UNIVAC 1004 Card Processor. UNIVAC Division of the Sperry-Rand Corporation.

Connection Panel Wiring Recommendations, Conventions, and Rules, UNIVAC 1004 Card Processor. UNIVAC Division of the Sperry-Rand Corporation.

Timing Cycles, UNIVAC 1004 Card Processor. UNIVAC Division of the Sperry-Rand Corporation.

UNIVAC 1004 II & III Card Processors Timing. UNIVAC Division of the Sperry-Rand Corporation.

Data Flow Transfer Operations, UNIVAC 1004 Card Processor. UNIVAC Division of the Sperry-Rand Corporation.

Translation of 80-column Punching, UNIVAC 1004 Systems. UNIVAC Division of the Sperry-Rand Corporation.

Add and Subtract (80-column), UNIVAC 1004 Card Processor. UNIVAC Division of the Sperry-Rand Corporation.

Compare Process, UNIVAC 1004 Card Processor. UNIVAC Division of the Sperry-Rand Corporation.

Translate Process, UNIVAC 1004 Card Processor. UNIVAC Division of the Sperry-Rand Corporation.

Double Punch - Blank Column Check, UNIVAC 1004 Card Processor. UNIVAC Division of the Sperry-Rand Corporation

Code Image, Addenda to Reference Manual, UNIVAC 1004 Card Processor. UNIVAC Division of the Sperry-Rand Corporation.

Scored Card Feature, UNIVAC 1004 Card Processor. UNIVAC Division of the Sperry-Rand Corporation.

Reference Manual, Auxiliary Card Reader, UNIVAC 1004 Card Processor. UNIVAC Division of the Sperry-Rand Corporation.

Paper Tape Reader, UNIVAC 1004 Card Processor. UNIVAC Division of the Sperry-Rand Corporation.

Read/Punch Unit, UNIVAC 1004 Card Processor. UNIVAC Division of the Sperry-Rand Corporation.

Introduction to Magnetic Tape, UNIVAC 1004 Systems. UNIVAC Division of the Sperry-Rand Corporation.

Reference Manual, Magnetic Tape Unit UNISERVO A. UNIVAC Division of the Sperry-Rand Corporation.

Reference Manual, Magnetic Tape Unit UNISERVO VI C. UNIVAC Division of the Sperry-Rand Corporation.

UNIVAC 1004 III Magnetic Tape Unit. UNIVAC Division of the Sperry-Rand Corporation.

Auxiliary Core Storage, UNIVAC 1004 Systems. UNIVAC Division of the Sperry-Rand Corporation.

Suggested Trainee Activities

Trainees should be assigned to develop wiring panels which would permit them to perform with the UNIVAC 1004 Card Processor the same operations that they learned on EAM in Unit I. These can be chosen by the instructor from among the problems presented by William E. Bux for the IBM 402 and 403 Tabulators. The problems should illustrate the functions of the sorters, collators, and interpreters as performed on the UNIVAC 1004 System.

Trainee Materials

1	Connection panel (wires as needed)
25	Connection panel charts
1	Flowcharting template
25	Coding forms UP-3315.3

Unit Outline for the IBM System/360 Model 20

A. Internal Organization of the Central Processing Unit
  1. Information locations
    a. Main storage
    b. Registers
  2. Information representation
    a. Information formats
      (1) Byte size and code
      (2) Word lengths and addresses
      (3) Numerical formats
        (a) Signed binary integers
          - Fixed point formats
          - Floating point formats
        (b) Decimal integers
          - Digit codes
          - Sign codes
          - Packed decimal numbers
          - Zoned decimal numbers
      (4) Logical formats
        (a) Fixed length
        (b) Variable length
        (c) Codes
          - EBCDIC
          - USASCII
          - Hexadecimal representation
    b. Instruction formats
      (1) Basic formats and functions
        (a) RR (register to register operation)
        (b) RX (register and indexed operand operation)
        (c) SI (storage and immediate operand operation)
        (d) SS (storage to storage operation)
      (2) Instruction components
        (a) Operation code
        (b) Operand register specification
        (c) Index register specification
        (d) Mask
        (e) Immediate data
        (f) Operand address
      (3) Address generation
        (a) Base address and location
        (b) Index
        (c) Displacement
    c. Program status word
      (1) Function
      (2) Format
      (3) Codes and meaning
  3. Programming
    a. Special purpose programs
    b. General purpose programs

B. Basic Utility Programs
  1. Purpose of basic utility programs (functions performed)
    a. Clearing the main memory
    b. Providing a standard technique for loading programs

    - c. Providing a standard way to obtain a record of the contents of the main storage
    - d. Providing a standard tool for tracing programs
2. Clear storage program
    - a. Function
    - b. Format (single 80-column card)
    - c. Operating procedures
    - d. Restart procedures
3. Absolute program loader
    - a. Function
    - b. Card formats
    - c. Operating procedures
    - d. Halts and restart procedures
4. Relocatable program loader
    - a. Functions and special capabilities
        - (1) Relocation
        - (2) Linkage
        - (3) Re-evaluation
        - (4) Interrupted loading
        - (5) Transferring control
    - b. Card deck description
        - (1) External symbol dictionary card
        - (2) Relocation list dictionary card
        - (3) Text card
        - (4) End card
        - (5) Set location counter card
        - (6) Include segment card
        - (7) Load terminate card
    - c. Operating procedures
        - (1) Absolute loading
        - (2) Relocatable loading
        - (3) Interrupted loading
        - (4) Relocation and linkage
    - d. Halts and restart procedures
5. Print storage program
    - a. Functions
    - b. Card deck description
        - (1) Standard card descriptions
        - (2) Specification card format
    - c. Operating procedures
        - (1) For 2501 Card Reader
        - (2) For 2520 Card Read-Punch
        - (3) For 2560 Multifunction Card Machine
6. Punch storage program
    - a. Functions
    - b. Card deck description
        - (1) Standard card descriptions
        - (2) Specification card format
    - c. Operating procedures
    - d. Halts and restart procedures
7. Basic trace program
    - a. Functions and capabilities
        - (1) Description of output
        - (2) Influence on program execution
        - (3) Limitations

- b. Description of object deck
- c. Operating procedures
  - (1) Loading
  - (2) System preparations
  - (3) Selective tracing under manual control
    - (a) Change from untraced to traced operation
    - (b) Change from traced to untraced operation
  - (4) Selective tracing under program control
- d. Halts and restart procedures

C. Punched Card Utility Programs

1. Collate program
   - a. Functions, use, and illustrations
     - (1) Merging two sorted files into one sorted file without selection
     - (2) Merging with selection
     - (3) Matching files card for card
     - (4) Matching group for group
     - (5) Matching or merging with detection of duplicates
     - (6) Selecting cards within limits
     - (7) Selecting zero balance cards
     - (8) Selecting first or last card of each group
     - (9) Selecting single card groups
     - (10) Inserting secondary cards into primary files based on conditions
     - (11) Sequence check for ascending or descending sequence
   - b. Checking features
     - (1) Consecutive number check
     - (2) Hash (or control) total
   - c. Preparing control specifications
     - (1) COLAT card
     - (2) FINDR card
     - (3) PLACE card
   - d. Preparing program run
     - (1) Preparing and assembling control deck
     - (2) Loading procedures
   - e. Operation
     - (1) Halts and diagnostics
     - (2) Method of clearing halts
   - f. Handling and marking output decks
2. Gangpunch-reproduce program
   - a. Functions
     - (1) Simple master card gangpunching
     - (2) Interspersed master card gangpunching
     - (3) Offset gangpunching
     - (4) Count controlled gangpunching
     - (5) Sequence numbering and sequence punching during gangpunching
     - (6) Straight reproducing
     - (7) Selective reproducing
     - (8) Combining gangpunching and reproducing
     - (9) Interpreting
   - b. Definition of card types
     - (1) Designations of cards
     - (2) Application rules

- c. Preparation of control specifications
  - (1) Specification form explanation
  - (2) Punching control cards, selector cards, and field identification cards
- d. Operation
  - (1) Preparation of decks
  - (2) Loading procedures
  - (3) Halts and restarts

3. List-summary-punch program
   - a. Functions
     - (1) Output capabilities
       - (a) Print listings and tabulations
       - (b) Punch summary cards
     - (2) Special provisions
       - (a) Two types of headings
       - (b) Address and comment lines from specified cards
       - (c) Three levels of control
       - (d) Accumulation of totals by addition or subtraction on specified fields
       - (e) Accumulation of card counts
       - (f) Printing of totals at each control level and at final level
       - (g) Editing of printed data
       - (h) Selectors for identifying card types
       - (i) Page overflow and numbering
       - (j) Summary punching at any control level
       - (k) Sequence checking of the input file
   - b. Program information requirements and card types
     - (1) Control cards
     - (2) Selector card
     - (3) Print definition cards
     - (4) Address or comment definition cards
     - (5) Report and heading definition card
   - c. Operation
     - (1) Preparation of decks
     - (2) Loading procedures
     - (3) Halts and restarts
4. Merge-sort program
   - a. Comparison of capabilities with punched card sorters
   - b. Functions and specifications
   - c. Operating procedures
     - (1) Preparation of decks
     - (2) Loading procedures
     - (3) Halts and restarts

D. Basic Assembler

1. Basic assembler language, IBM System/360 Model 20
   - a. Versions and minimum equipment requirements
     - (1) Tape system
     - (2) Card system
   - b. Programming facilities
     - (1) Mnemonic operation codes
     - (2) Symbolic referencing of storage addresses
     - (3) Automatic storage assignment
     - (4) Convenient data representation

- (5) Renaming symbols
- (6) Program linking
- (7) Option for absolute or relocatable programs
- (8) Program listing and error checking

- c. Formats of language statements
  - (1) Name field
  - (2) Operation field
  - (3) Operand field
  - (4) Comments field
  - (5) Identification sequence field
- d. Character set
- e. Symbols, their use and definition

- 2. Basic assembler program
  - a. Card version
    - (1) Preparation of decks
    - (2) Pass 1 loading procedure
    - (3) Pass 1 operating procedure
    - (4) Pass 2 loading procedure
    - (5) Pass 2 operating procedure
    - (6) Forms and disposition of outputs
  - b. Tape version

E. Report Program Generator

- 1. Purpose, general functions and advantages
  - a. Report writing
  - b. Summary punching
  - c. Merging
  - d. Matching
  - e. Gangpunching
  - f. Calculating
  - g. Reproducing
  - h. Interpreting
  - i. Card selection
- 2. Programmer functions
  - a. Problem analysis
  - b. Preparation of specifications
    - (1) Input specifications
    - (2) Calculation specifications
    - (3) Ouput format specifications
    - (4) File description specifications
    - (5) File extension specifications
  - c. Preparation of control decks
- 3. Operating procedures
  - a. Preparation of machine configuration
  - b. Assembling and loading input and program decks
  - c. Generation run operating procedures
  - d. Object run operating procedures
  - e. Forms and dispositions of output

Teaching Aids

Computer Programming. Film. System Development Corporation

Punched Card Utility Program COLLATE Specification Sheet COLAT. International Business Machines Corporation.

Punched Card Utility Program COLLATE Specification Sheet FINDR. International Business Machines Corporation.

Punched Card Utility Program COLLATE Specification Sheet PLACE. International Business Machines Corporation.

Gangpunch-Reproduce Specification Sheet. International Business Machines Corporation.

List-Summary Punch Program Specification Sheet 1. International Business Machines Corporation.

List-Summary Punch Program Specification Sheet 2. International Business Machines Corporation.

Report Program Generator Input Specification Sheet. International Business Machines Corporation.

Report Program Generator Calculation Specification Sheet. International Business Machines Corporation.

Report Program Generator Output Format Specification Sheet. International Business Machines Corporation.

Report Program Generator File Description Specification Sheet. International Business Machines Corporation.

Report Program Generator File Extension Specification Sheet. International Business Machines Corporation.

IBM 1443 Printer Spacing Chart. International Business Machines Corporation.

Instructor Reference Materials

Introduction and System Summary. International Business Machines Corporation.

Model 20 Functional Characteristics. International Business Machines Corporation.

2520 Card Read-Punch. International Business Machines Corporation.

2501 Card Reader. International Business Machines Corporation.

2560 Multi-Function Card Machine. Internationa Business Machines Corporation.

2203 Printer. International Business Machines Corporation.

1403 Printer. International Business Machines Corporation.

1442-5 Card Punch. International Business Machines Corporation.

1219 Reader Sorter, 1419 Magnetic Character Reader. International Business Machines Corporation.

High-Speed Reader Sorter Operations Manual. International Business Machines Corporation.

2400 and 2816 Model 1. International Business Machines Corporation.

IBM System/360 Principles of Operation. International Business Machines Corporation.

IBM 729, 7330, and 727 Magnetic Tape Units Principles of Operation. International Business Machines Corporation.

Model 20 Basic Assembler Language. International Business Machines Corporation.

Model 20, Basic Assembler Operating Procedures (Tape). International Business Machines Corporation.

Model 20, Basic Assembler Operating Procedures (Card). International Business Machines Corporation.

Model 20 Disk and Tape Programming Systems, Assembler Language. International Business Machines Corporation.

Model 20 Punched Card Utility Programs. International Business Machines Corporation.

Model 20 Punched Card Utility Programs, Operating Procedures. International Business Machines Corporation.

Model 20 Basic Utility Programs, Functions and Operating Procedures. International Business Machines Corporation.

Model 20 Report Program Generator for Punched Card Equipment. International Business Machines Corporation.

Model 20 Report Program Generator for Punched Card Equipment, Operating Procedures. International Business Machines Corporation.

Model 20 Disk and Tape Programming Systems, Report Program Generator. International Business Machines Corporation.

Suggested Trainee Activities

Have the trainees identify the functions which they performed in the exercises in Unit I, EACM and Punched Card Principles, in terms of functions performed by the various Model 20 utility pachages. Assign the trainees to develop simple specifications to perform several functions both with the utility system and with the report program generator sustem. Assign different trainees slightly different configurations and have them discuss the differences in the specification.

Unit V

LARGE STORED PROGRAM COMPUTERS

Training Time Classroom 53 hours; Field trips 20 hours

Objectives

To acquaint the trainees with the general history of the computer industry.

To instruct the trainees in the general characteristics of the larger third generation computer for which they will be specially trained and qualified.

To inform the trainees of the similarities and differences between the chosen computer and other members of the third generation families.

To introduce the trainees to the functions, duties, and responsibilities of the operator of a third generation computer.

Unit Outline

A. General Survey of the Industry
  1. Equipment history
    a. Census of 1890 and the development of punched cards
    b. 80 and 90 column cards and the history of office equipment manufacturers, IBM and Remington Rand
    c. Early relay and vacuum tube computers
    d. Commercial vacuum tube computers of the first generation
    e. Commercial transistorized computers of the second generation
    f. Commercial integrated circuit computers of the third generation
  2. Organizational history
    a. Equipment manufacturers
    b. Software houses
    c. Service bureaus
  3. Description of types of equipment still in use
    a. Accounting machinery, models and manufacturers
      (1) Keypunches and verifiers
      (2) Sorters and collators
      (3) Interpreters
      (4) Tabulators and printers
    b. Computers, models and manufacturers
      (1) Engineering computers
      (2) Business computers
      (3) Process control computers
      (4) Multiple purpose computers
    c. Periodic industrial surveys
      (1) Government reports
      (2) DATAMATION survey
      (3) Computers and Automation survey
      (4) Adams Associates survey
      (5) Auerbach reports

- B. Computer Comparisons
  - 1. General comparison parameters
    - a. Memory characteristics
      - (1) Capacity
        - (a) Bits
        - (b) Bytes or characters
        - (c) Words
      - (2) Speed
        - (a) Read cycle
        - (b) Read-write cycle
        - (c) Concurrent operations (time sharing, asynchronous operation
        - (d) Memory levels
          - Scratch pad memories
          - Read only memories
          - Main memory
          - Auxiliary memories
      - (3) Special features
        - (a) Memory protection (keyed access to zones)
        - (b) Multiple access (multiprocessors)
        - (c) Indexed access
        - (d) Base addresses and program relocatability
    - b. Operations and operating speeds (CPU, central processing unit)
      - (1) Logical operations
        - (a) Comparisons
        - (b) Masked operations
        - (c) Shifts
        - (d) Tests
        - (e) Addressability of data elements
      - (2) Arithmetic operations
        - (a) Addition and subtraction
        - (b) Multiplication
        - (c) Division
        - (d) Special routines
    - c. Special features
      - (1) Input/output channels and channel capacity
        - (a) Channel capacity
        - (b) Number of independent channels
        - (c) Amount of CPU attention required for direct transfers into and out of memory
        - (d) Kinds of channel interruption provided
        - (e) Kinds of CPU interruption and signalling provided
      - (2) Peripheral storage, capacity, access rates, data rates
        - (a) Magnetic tapes and tape handlers
        - (b) Magnetic disks
        - (c) Magnetic drums
        - (d) Magnetic cards and strips
        - (e) Optically readable external storage devices
      - (3) Input/output units
        - (a) Card readers and punches
        - (b) Paper tape readers and punches
        - (c) Magnetic tapes, strips, and disk packs
        - (d) Printers
        - (e) Visual display devices
        - (f) Graphic devices (input and output)

            - (g) Optical readers (printed matter)
            - (h) Magnetic ink equipment
            - (i) Direct data inscribers
- 2. Application parameters
    - a. Problem characteristics
        - (1) Input/output limited applications
        - (2) File handling problems
        - (3) Computational problems
        - (4) Large matrix problems
    - b. Software characteristics (operating systems)
        - (1) Types of software facility
            - (a) Utility programs
            - (b) Compilation systems
            - (c) File management systems
            - (d) Special systems
        - (2) Important traits
            - (a) Adequacy and clarity of documentation
            - (b) Ease of use and control
            - (c) Flexibility
            - (d) Restrictions on size of programs and on length of batches
            - (e) Completeness of diagnostics
            - (f) Efficient use of peripheral equipment
            - (g) Standardization and compatibility
    - c. Cost comparisons
        - (1) Computation of fixed costs
        - (2) Workload capacity
- 3. Recent technological advances
    - a. Relationship between size and internal speed - integrated circuit developments
    - b. Thin film memories and special algorithms
    - c. Mass memory techniques and problems of input and output
    - d. Increases in speed, reliability, and cost changes
    - e. Remote terminal operation

C. Principal Characteristics of Third Generation Computers
- 1. Component differences
    - a. Integrated circuits
        - (1) Increased speed
        - (2) Decreased equipment size
        - (3) Lowered manufacturing costs
        - (4) Reduced power requirements
        - (5) Increased reliability
        - (6) Simplified maintenance
    - b. Thin film memories
        - (1) Increased speed of read and write cycles
        - (2) Elimination of need for write cycle in plated wire versions
        - (3) Additional functions
            - (a) Special algorithms possible
            - (b) Scratch pad memories
            - (c) Read-only memories
- 2. System improvements
    - a. New emphasis on compatibility and standardization of software packages, universally supplied by manufacturers
        - (1) Compatible programming languages

        - (a) FORTRAN
        - (b) ALGOL and dialects
        - (c) COBOL
    - (2) Data handling systems and report generator programs
    - (3) Special purpose systems
        - (a) Mathematical programming
        - (b) Statistical analysis packages
        - (c) Simulation systems
        - (d) Planning systems
- b. Compatibility of hardware components
    - (1) Unified design for entire families of computers
        - (a) Card oriented computers
        - (b) Tape and disk oriented computers
        - (c) Remote processing computers
    - (2) Universality of application
        - (a) Scientific and engineering calculations
        - (b) Business applications
        - (c) Large information retrieval applications
        - (d) Combinations
    - (3) Compatibility among system elements
        - (a) Upward compatibility of central processors
        - (b) Limited downward compatibility of central processors
        - (c) Compatibility of peripheral equipment with all central processors
- c. Operational features
    - (1) Standardized transmission of data codes
    - (2) Extensions of parity checking
    - (3) Improved interruption systems
    - (4) Sharing of central memory among several central processing units
    - (5) Protection of main storage
        - (a) Against unauthorized storing
        - (b) Against unauthorized fetching
        - (c) Against unauthorized keys

- D. Duties of Operators
    - 1. Review of material in Unit II, section C
    - 2. Place of operators in the data processing team
        - a. Management (including supervisor)
            - (1) Planning
            - (2) Scheduling
            - (3) Marketing
            - (4) Resource allocation
            - (5) Setting and enforcing standards
        - b. Programming
            - (1) Providing programs and corrections
            - (2) Providing test data and instructions
            - (3) Providing operating instructions
            - (4) Observing operation (at discretion of management
        - c. Operations
            - (1) Setting up the system
            - (2) Running programs in accordance with standard procedures and programmer instructions
            - (3) Providing programmer with results of processing including observations of operating conditions associated with

failures

- (4) Maintaining operations records
- (5) Maintaining libraries
  - (a) Card decks
  - (b) Master tapes
  - (c) Save tapes
  - (d) Scratch tapes
  - (e) Disk packs
  - (f) Operations manuals
  - (g) Operations records
- d. Customer engineering
  - (1) Performing scheduled maintenance
  - (2) Correcting system malfunctions
  - (3) Coordinating corrections in program packages supplied by the manufacturer

3. General responsibilities
   - a. Assisting programmers
     - (1) Performing runs accurately in accordance with instructions of the programmer
     - (2) Protecting tapes and card decks
     - (3) Observing and recording results carefully
     - (4) Answering programmer's questions
   - b. Remaining alert to safety precautions
     - (1) Not operating equipment with covers open
     - (2) Not clearing jams while equipment is running
     - (3) Not removing covers except in accordance with specific instructions
     - (4) Not using power extension cords around equipment.
   - c. Remaining alert to implement emergency procedures
     - (1) Power failure procedure
     - (2) Air conditioning failure procedure
     - (3) Flooding procedures
       - (a) Minor floods
       - (b) Major floods
     - (4) Personal injury procedures
   - d. Saving evidence of failures for customer engineers and programmers
4. Routine duties
   - a. Caring for cards
     - (1) Inspecting for damage
       - (a) Bending
       - (b) Folding
       - (c) Tearing
     - (2) Reconditioning
     - (3) Reproducing
     - (4) Storing
       - (a) Pressure blocking
       - (b) Protecting against mechanical damage
       - (c) Conditioning to proper temperature and humidity
   - b. Caring for magnetic tape reels
     - (1) Preventing warping
     - (2) Preventing breakage

c. Caring for magnetic tapes
  (1) Protecting against creasing
  (2) Protecting from dust
  (3) Avoiding oil on oxide
  (4) Cleaning procedures
  (5) Special precautions
    (a) Mounting only on clean transport
    (b) Exercising care with write-protect ring

d. Caring for disk packs
  (1) Using proper handling devices
  (2) Inspecting for proper seating
  (3) Protecting against mechanical damage
  (4) Protecting against extraneous material
  (5) Storing properly

e. Perforated tape
  (1) Protecting against special hazards
    (a) Tearing
    (b) Bending
    (c) Water
    (d) Dust
  (2) Proper storing conditions
    (a) Temperature
    (b) Humidity
    (c) Protection against strong magnetic fields
      - Motors
      - Circuit breakers
      - Magnetic locking devices
      - Strong electric currents

f. Marking and maintaining records
  (1) Marking standards
  (2) Record standards

E. Introduction to the Computer of Specialization (an Overview)

1. General introduction to the family of computers
  a. Numbering system of models
  b. Special trade name
  c. Date of introduction
  d. Numbers in use and their distribution
2. Central processing unit (CPU)
  a. Model differences
    (1) Memory reference (main memory)
      (a) Size
      (b) Speed
    (2) Typical operation times
      (a) Arithmetic operations
      (b) Logical operations
    (3) Major differences in instruction repertoire
      (a) Wired instructions
      (b) Instructions provided in the assembly program
    (4) Special registers
      (a) Wired
      (b) Simulated in memory
    (5) Special thin film memories
    (6) Other special features
  b. Special characteristics of the family

        - (1) Expandability of memory
        - (2) Interruption system
        - (3) Parity checking system
        - (4) Storage protection features
            - (a) Fetch protection
            - (b) Store protection
        - (5) Multiprocessor characteristics
3. Operator's control station
    - a. Control console
        - (1) Control panel or panels
            - (a) Status lights
            - (b) Control switches
            - (c) Register readout lights
            - (d) Information entry switches
        - (2) Typewriter
            - (a) Typewriter control switches
            - (b) Typewriter keyboard
    - b. Printer (optionally useable as supervisory unit for operator or for program output)
4. General operating procedures
    - a. General background
        - (1) Functions of status lights and indicators
        - (2) Functions of control switches
        - (3) Functions of the typewriter
    - b. Start-up procedures
        - (1) Verifying temperature and humidity
        - (2) Loading paper in typewriter
        - (3) Starting up console
        - (4) Starting up typewriter
5. Peripheral equipment
    - a. Card equipment
        - (1) Card readers
            - (a) Models and model differences
            - (b) Nomenclature of principal parts
            - (c) Start-up procedures
            - (d) Loading procedures
            - (e) Malfunctions and corrective action
        - (2) Card punches
        - (3) Combination card machines
    - b. Printers
        - (1) Models and model differences
        - (2) Nomenclature of principal parts
        - (3) Start-up procedures
        - (4) Loading procedures
        - (5) Malfunctions and corrective action
        - (6) Special precautions
    - c. Magnetic records
        - (1) Magnetic tapes and tape transports
        - (2) Magnetic disk files
        - (3) Magnetic card files
        - (4) Magnetic drums
    - d. Magnetic ink devices
    - e. Optical devices
        - (1) Display equipment
        - (2) Optical character readers

            - (3) Graphic input devices
        - f. Input/output control devices
            - (1) Selector channels
            - (2) Multiplexor channels
    - 6. Remote equipment
        - a. Remote communication equipment
        - b. Remote keyboard terminals
        - c. Remote keyboard and display terminals
        - d. Remote card input devices
        - e. Programmable remote communication control equipment
            - (1) Models and model differences
            - (2) Nomenclature of principal parts
            - (3) Programming procedures
            - (4) Start-up procedures
            - (5) Malfunctions and corrective action

F. Survey of Remaining Third Generation Computers
- 1. Major manufacturers
    - a. Numbering of models
    - b. Special trade names
    - c. Date of introduction
    - d. Numbers and distribution of the type
- 2. Comparison of general configurations
    - a. Central processing units
        - (1) General range of characteristics
        - (2) Special characteristics
    - b. Peripheral equipment
        - (1) Card equipment
        - (2) Printers
        - (3) Magnetic records
        - (4) Magnetic ink devices
        - (5) Optical devices
        - (6) Input/output control devices
    - c. Remote equipment
        - (1) Remote communication equipment
        - (2) Remote terminals
        - (3) Programmable remote communication control equipment
    - d. Examples of configurations

G. Special Caution to Computer Operators
- 1. Necessity for continuous study of the computer
    - a. Equipment and equipment changes
    - b. Software packages
    - c. Operating procedures
- 2. Cost of errors by operator
- 3. Necessity for reference to manuals and danger of relying on memory
- 4. Importance of saving everything. "Let your supervisor throw it out."

Teaching Aids

Automation in the Air Traffic Control. Film. UNIVAC Division of the Sperry-Rand Corporation.
Census '60. Film. Data Processing Management Association.
Digital Computer Techniques - Computer Units. Film. United States Navy.

The Electronic Retina Computing Reader. Film. Recognition Equipment, Incorporated.
The Electronic Shelf. Film. UNIVAC Division of the Sperry-Rand Corp.
The IBM 1428 Alphameric Optical Reader. Film. International Business Machines Corporation.
Memory Devices. Film. Western Electric.
Principles of Electronic Data Processing. Film. International Business Machines Corporation.
Then and Now. Film. UNIVAC Division of the Sperry-Rand Corporation.
What Do You Want. Film. UNIVAC Division of the Sperry-Rand Corporation.

Special Note: Since the industry possesses a dynamic market, one which is particularly oriented toward training, local manufacturer's representatives should always be approached for the latest instructional aids which their firms may have available.

Instructor Reference Materials

The latest manuals for the computer of choice should be obtained from the local manufacturer's representative.

The instructor will need recent copies of two periodicals which conduct continuing surveys of the computer market and report on sales, installations, etc. These are DATAMATION and Computers and Automation.

Chu, Yoahan. Digital Computer Design Fundamentals.

Huskey, Harry D. and Korn, Granino. Computer Handbook.

The instructor will also find useful information in an annual publication of the Subcommittee on Census and Government Statistics of the Committee on Post Office and Civil Service, House of Representatives. Inventory of Automatic Data Processing (ADP) Equipment in the Federal Government.

Suggested Trainee Activities

Issue each trainee a copy of the Operator's Guide for the computer of specialization, and a general system descriptive document. Encourage the trainees to use the guides to diagnose malfunctions which occur and to identify proper corrective procedures. The trainee should study the material and bring the guide with him whenever he visits the computer installation. Some manufacturers have additional memory prompting cards, templates, etc., designed for the convenience of the operator. The operator should be encouraged to carry them with him at all times.

Note to the Instructor

The training time allocation assumes that five mornings or afternoons will be spent on visits to five different computer installations. It is recommended that the demonstrations be conducted by either a manufacturer's representative or by the supervisor of the installation, unless the instructor himself is quite familiar with the installation.

Emphasis during the demonstration should cover the interests of the operator and illustrate his functions. It is recommended that the trainees be given a tour through the entire installation including the library, that they be shown the forms and records, and that they be given a demonstration of the entire process of receiving and logging a work order, of checking and retrieving the necessary materials such as card decks, tapes, and disk packs, of coordinating schedule problems and communicating with the programmer or analyst ordering the computer run, of performing the necessary operations, responding to problems, and of making final disposition fo the results.

Unit VI

INTRODUCTION TO THE COMPUTER OF SPECIALIZATION

Training Time — Classroom 40 hours; Laboratory 9 hours.

Objectives

To acquaint the trainee with the internal structure and organization of the third generation series computer in which the trainee will specialize.

To familiarize the trainee with the instruction set in assembly language so that the trainee can follow a simple program.

To acquaint the trainee with the major sources of programming problems which lead to processing or assembly errors.

To familiarize the trainee with the major forms of program documentation.

To give the trainee sufficient practice in analyzing simple programs so that he will be able to comprehend the various kinds of program and better understand the actions required of him to operate the system and to clear system operating problems.

Unit Outline

A. General Introduction
    1. Review of data processing concepts and of flow charting
        a. Basic symbols and their meaning
            (1) Start and end symbols and connectors
            (2) Processes
            (3) Tests
        b. Examples of simple flow charts
            (1) Data input
            (2) Data manipulations
            (3) Computations
            (4) Data outputs
    2. Computer storage and addressing
        a. Data structure
            (1) Byte size
            (2) Word structure
            (3) Partial and multiple words
            (4) Representation
                (a) Binary format and sign
                (b) Decimal format and sign
                (c) Floating point binary
                (d) Floating point decimal
                (e) Multiple precision
        b. Addressing
            (1) Main memory addresses
            (2) Addressable registers
            (3) Address representation

        - c. Instruction formats
            - (1) Operation code and modifiers
            - (2) Address
                - (a) Location
                - (b) Index
                - (c) Base address
                - (d) Direct data
        - d. Arithmetic and control registers
            - (1) Accumulator and quotient registers
            - (2) Program status word register

- B. Assembly Language and the Assembler
    - 1. Purpose of the assembler
        - a. Translate convenient mnemonics to machine language
        - b. Facilitate bookeeping
        - c. Reduce repetitive labor by programmer
        - d. Facilitate relocation of program in memory when loaded
        - e. Use machine capabilities to diagnose programmer errors
        - f. Announce identified errors to operator and programmer
    - 2. Coding forms
    - 3. Assembly language statement types
        - a. Machine instructions
        - b. Macro-instructions
        - c. Control instructions
        - d. Comments
    - 4. Definition of machine requirements
        - a. Memory capacity
        - b. Availability of peripheral equipment
            - (1) Availability of tapes and designations
            - (2) Availability of disks or drums and designations
            - (3) Availability of card equipment
            - (4) Availability of printer and designations
            - (5) Other equipment designations and availability
        - c. Allocation of functions
            - (1) Location of control cards
            - (2) Location of source program cards
            - (3) Location of assembler program
            - (4) Location of object program area
            - (5) Location of working areas
            - (6) Type and location of output device for diagnostic and control messages
            - (7) Preparation of control cards
                - (a) Format
                - (b) Symbols
    - 5. Control instructions
        - a. Program sectioning and linking instructions
            - (1) Start instruction
            - (2) End instruction
            - (3) Identification of program sections and entry points
            - (4) Identification of external symbols
        - b. Program control
            - (1) Input control instructions
            - (2) Print control instructions
            - (3) Card generation control instructions
        - c. Data control

            (1) Data definition instructions
            (2) External storage location instructions
        d. Addressing
            (1) Relocatability
                (a) Direct addressing
                (b) Indirect addressing
                (c) Relative addressing
            (2) Register usage
            (3) Register control instructions
    6. Comments
    7. Machine instructions
        a. Format of statements
            (1) Operand fields
            (2) Operation fields
            (3) Lengths
        b. Operation codes
            (1) Binary arithmetic instructions
            (2) Decimal arithmetic instructions
            (3) Floating-point arithmetic instructions
            (4) Logical operation instructions
    8. Macro-instructions
        a. General
            (1) Use and utility of macros
            (2) Macro definition library
        b. Macro-instruction formats
            (1) Header statements
            (2) Trailer statements
            (3) Sample functions
                (a) Moving data
                (b) Assigning values to symbols
                (c) Branching on conditions
                (d) Controlling inputs and outputs

C. Analysis of Typical Programs and Program Modification
    1. Program documentation
        a. Logical flow diagrams
        b. Verbal flow descriptions
        c. Data specifications
            (1) Format
            (2) Coding
            (3) Range
            (4) Organization
            (5) Identity tags or names
        d. Source and object decks and listings
        e. Error messages
    2. Program analysis
        a. Sample programs
            (1) Reading cards
            (2) Printing edited card images
            (3) Storing cards on peripheral equipment
                (a) Tape
                (b) Disk
        b. Familiarization with documentation
            (1) Flow charts (or verbal flow descriptions)
            (2) Listing of source decks

    - (3) Listing of object program
  - c. Analysis of data
    - (1) Coding of data and data names
    - (2) Data formats and organization
    - (3) Memory allocation
    - (4) Peripheral storage allocation
  - d. Analysis of assembler error messages
    - (1) Error message formats
    - (2) Error message content
    - (3) Identification of error source
    - (4) Correction of error
- 3. Program modification
  - a. Recoding, card correction, and reassembly
  - b. Patching
- 4. Program testing
  - a. Design of test
    - (1) Selecting critical functions
    - (2) Preparing test data
    - (3) Preparing test results
  - b. Running test
  - c. Comparing output with expected results
  - d. Identifying and correcting errors

Teaching Aids

The instructor should prepare simple programs illustrating the sample programs required for C, 2, a, items (1) through (3). There should be a logical flow diagram or a verbal flow description for each program. He should have listings of both the source and object decks and the printouts from the assembler run. He should also prepare and document test data.

When the instructor has his program running, he should introduce some representative errors into the source deck and obtain the resultant error printouts. These materials will be necessary for Part C of the unit.

Instructor Reference Material

Software systems are very changeable, and the documentation is quickly out of date. The instructor should take care to obtain the very latest documentation available. If the supplier of computer time uses a standard software package, the instructor may obtain documentation from the equipment manufacturer's representative; otherwise he should obtain the documentation from the supplier of the computer time.

The documentation required includes the various equivalents of the IBM User's Guide, Functional Characteristics, Assembler Language Description, and Assembler Operating Procedures.

Suggested Trainee Activities

The trainees must be encouraged to carry with them the Operator's Guide and Operation Instructions. During the course of the demonstrations, the trainees should be guided by the instructor to use their operators reference materials to diagnose the error situations as they arise, and to recommend to the instructor whose actions which they think are required by their diagnoses. The changes in card decks will have to be made by the instructor, since the level of the course does not qualify the trainees as programmers. As far as possible, the instructor should arrange to have some of the computer runs made with the trainees actually in attendance to observe the entire procedure.

Unit VII

OPERATING SYSTEMS

Training Time Classroom 48 hours; laboratory 40 hours

Objectives

To introduce the trainees to the function, structure, and internal logic of the batch processing operating system of the computer on which they are specializing.

To qualify the trainees fully for the performance of routine computer operations.

To introduce the trainees to the effective use of the operating system in solving more complex computer operating problems.

Unit Outline

A. Operator Responsibilities
   1. Review of material in Unit II, C, Fundamentals of Computer Operations
   2. Review of material in Unit V, Larger Stored Program Computers
   3. Major responsibilities
      a. Cleanliness of computer room - how and why necessary
      b. Orderliness of operation - rationale of governing rules
      c. Prompt recognition of problems
      d. Correct response to problems
      e. Exact conformity of operations with approved procedures and standards
      f. Maintenance of quality and production control
   4. Place and importance of the operator
      a. Within the organization
      b. With customers

B. Introduction to the Operating System
   1. Manufacturer-supplied system
      a. Functions
         (1) Control of peripheral equipment
            (a) Establishment of communication channels
            (b) Suspending communication channels
            (c) Activating peripheral units
            (d) Deactivating peripheral units
            (e) Surveying units for readiness states
               - Ready to transmit
               - Ready to receive
               - Not ready and not alerted
               - Not ready and busy
         (2) Internal control of CPU
            (a) Interrupt handling

                (b) Transfer of control
                (c) Memory utilization and accounting
                (d) Base address control
                (e) Memory protection administration
            (3) Processing control
                (a) Priority administration and program scheduling
                (b) Storage planning and allocation
                (c) Input/output transfer scheduling and control
                (d) Communication with operator
                (e) System usage accounting
        b. Purpose
            (1) Efficiency
                (a) Achieve maximum concurrent use of all elements of the system
                (b) Minimize time which equipment must wait for operator decisions
                (c) Exploit machine diagnostic capabilities and communicate them expeditiously to operator
            (2) Flexibility
                (a) Accommodate large and small programs
                (b) Easily shift configuration to fit program
                (c) Easily specify processing rules
    2. Locally designed and implemented modifications
        a. Functions
        b. Reason for modification

C. Operating Procedures
    1. Review of start-up and shut-down procedures
        a. Routine shut-down procedure
        b. Emergency shut-down procedure
    2. Bootstrapping
        a. Settings of peripheral equipment
        b. Settings and signals on console
        c. Loading of tapes
        d. Initiating bootstrap
        e. Normal signals on completion of bootstrap operation
        f. Diagnostics of bootstrap errors
            (1) Unallowable configurations of equipment
            (2) Unallowable information formats
            (3) Discrepancies in storage allocation
            (4) Equipment fault
        g. Corrective actions
    3. Halts
        a. Source of halt
            (1) Machine fault
            (2) Programmed halt
            (3) Operator routine initiative
            (4) Operator catastrophy response
        b. Diagnosis of cause of halt
            (1) Console or printer messages
            (2) Reference to operator manuals and programmer documentation
            (3) Observation of status lights
            (4) Tests
        c. Selection of corrective action

- (1) Prerogative
  - (a) Operator prerogative
  - (b) Reference required to supervisor
  - (c) Reference required to programmer
- (2) Decision
  - (a) Continue processing after dump
  - (b) Continue processing without dump
  - (c) Error termination with dump
  - (d) Abort (no dump)
- (3) Corrective actions

4. Memory dumps
   - a. Service objective
     - (1) Aid programmer in debugging
     - (2) Aid operator
     - (3) Aid maintenance
   - b. Panic dump
     - (1) Causes and system states
     - (2) Dump criteria
     - (3) Initiating procedure
     - (4) Procedure for continuing processing
   - c. Normal dumps
     - (1) Message format and content and device
     - (2) Analysis of correct response
       - (a) Reference to operating manuals
       - (b) Reference to programmer instructions
     - (3) Procedure for taking dumps
       - (a) Initiation
       - (b) Beginning address
       - (c) Ending address
       - (d) Termination and disposition of results
5. General operations
   - a. Run preparation
     - (1) Analyzing programmers instructions
     - (2) Assembling materials
       - (a) Card decks
       - (b) Master tapes
       - (c) Save tapes
       - (d) Scratch tapes
     - (3) Preparing control cards
     - (4) Determining running sequences
   - b. Executing run
     - (1) Load preparations and precautions
       - (a) Prior to run initiation
       - (b) Augmentation during running
     - (2) Console messages
       - (a) Notification of current program
       - (b) Requests for date and time
       - (c) Requests for equipment allocations and assignments
       - (d) Advanced notification (tape changes, etc.)
       - (e) Requests for changes in console settings
       - (f) Requests for alterations in peripheral equipment
       - (g) Requests for dismounting tapes and disks
   - c. Operator intervention
     - (1) Response to console messages
       - (a) Resume operation after pause

      (b) Resume operation after corrective action
      (c) Resume operation after altering operating mode
      (d) Execute trace
      (e) Execute dump
      (f) Reset peripheral equipment
      (g) Correct equipment faults
    (2) Force error halt
      (a) Correct key-in
      (b) Select dump
    (3) Force abort
    (4) Alter priorities
  d. Special operations exploiting special characteristics of the operating system

D. Planning Computer Operations
 1. Operating system characteristics
  a. Maximum core load, single program
  b. Number of programs which can be handled concurrently by operating system and storage
  c. Input/output discipline and equipment allocations and requirements
  d. Priority and control discipline
 2. Program and data requirements
 3. Production planning procedures
  a. Determination of priorities and preferred sequence
  b. Planning of storage allocations and allocations of peripheral equipment
  c. Establishment of stacking and control sequences
  d. Preparation of control cards
 4. Preparation of materials
  a. Identifying and retrieving master and save tapes
  b. Checking tape and disk pack conditions
  c. Creating required tapes and disk packs, duplicating and prestoring
  d. Preparing loading plan
  e. Preparing control messages for control deck

E. Practical Problems
 1. Running single load programs
 2. Running sequential program stack
 3. Running interleaved programs
 4. Running programs with multiple data requirements
 5. Practice in special operations
  a. Tracing specified loops and branches
  b. Taking specified dumps
 6. Practice in diagnosing faults
  a. Clearing card reader halts
    (1) Card jams
    (2) Empty hopper
    (3) Incorrectly assembled card decks
    (4) Incorrectly punched control cards
  b. Clearing printer halts
    (1) Out of paper
    (2) Machine faults
    (3) Channel problems

Teaching Aids

Since the primary purpose of this unit is to qualify the trainees as operators under a specific operating system, the most important teaching aids are the operator's manuals and prompting charts produced by the manufacturers and by the developers of the specific operating systems being taught. Special prompting aids may also have been developed by the operating unit of the computer installation which is being used for the laboratory sessions.

Instructor Reference Materials

Instructor reference materials can be specified only with respect to type, because they are dependent entirely upon the choice of computer and the operating sustem being taught. The instructor will require, in addition to the materials provided to the student, the following materials: system descriptions, equipment descriptions, user's guide, programmer's guide, and operating system descriptions.

Suggested Trainee Activities

The class should develop from notes, operator's manuals, and observation of operations, prompting aids which they feel would assist them most effectively in operating the computer efficiently. This should be a continuous project from this point onward during the course. The instructor should emphasize the need for operators to continuously improve their efficiency and skills and the need for continuous improvement of the tools of the operator to meet the ever changing demands upon him.

Suggested Text Assignments

In addition to the operator's guide or operation instructions issued during Course Unit VI, the trainee will require reference manuals listing the console messages and corrective actions provided by the operating system. The trainee will also require the manual which explains the preparation of control cards and the rationale for grouping and stacking programs to be run.

Unit VIII

HIGHER ORDER PROGRAMMING LANGUAGES (FORTRAN AND COBOL)

Training Time Classroom 31 hours; Laboratory 8 hours

Objectives

To introduce the trainees to higher order, problem oriented languages so that they can understand their advantages and the objectives of compilation.

To qualify the trainees to run FORTRAN compilers and COBOL processors.

To familiarize the trainees with the problems which arise during program compilation and debugging so that they can provide intelligent support to programmers.

Unit Outline

A. Introduction to Higher Order Programming Languages
  1. Purpose of assemblers
    a. Reduce repetitive writing of instruction code
    b. Permit writing relocatable programs
    c. Reduce programmer errors
  2. Purpose of problem oriented languages
    a. Reduce the need for programmers to understand the intricacies of data manipulation in the computer
    b. Produce programs more rapidly
    c. Exploit the capabilities of the machine to detect logical errors
    d. Improve the readability of computer programs to the individuals who must maintain and modify the programs
  3. Independence of the computer configurations for the object program from the configuration on which the compilation is made

B. Introduction to FORTRAN (FORmula TRANslation)
  1. Purpose of the language
    a. Support engineering programming and computation
    b. Support scientific work
  2. Relationship to other languages
    a. ALGOL (ALGOrithmic Language)
    b. JOVIAL (Jules Own Version of the International Algebraic Language)
    c. NELIAC (Naval Electronics Laboratory International Algebraic Compiler)
    d. BASIC (Dartmouth University computer language)
    e. P/L I (IBM's new programming language for the System/360)
  3. Language elements
    a. Operands
      (1) Variables

(2) Constants
(3) Arrays
b. Operations
  (1) Addition
  (2) Subtraction
  (3) Multiplication
  (4) Division
  (5) Exponentiation
b. Statements
  (1) General rules
  (2) Arithmetic statements
  (3) Specification statements
    (a) Dimension statements
    (b) Common statements
    (c) Equivalence statements
  (4) Control statements
    (a) GO TO statements
    (b) IF statements
    (c) DO statements
    (d) CONTINUE statements
    (e) PAUSE statements
    (f) STOP statements
    (g) END statements
  (5) Sequential input/output statements
    (a) READ statements
    (b) WRITE statements
    (c) FORMAT statements
  (6) Direct access input/output statements
    (a) DEFINE FILE statements
    (b) READ statements
    (c) WRITE statements
    (d) FIND statements
4. Program structure
  a. Main program
  b. Subprogram
    (1) Rules
      (a) Statement functions
      (b) Function subprograms
      (c) Subroutine subprograms
    (2) Sources
      (a) Programmer design
      (b) Library subprograms
      (c) In-line compiler subprograms

C. FORTRAN Compiler
  1. Major functions of compilation
    a. Syntactic check of source program
    b. Data analysis
      (1) Identification of data requirements and assignments
      (2) Establishment of format and coding
      (3) Specification of space requirements
    c. Configuration analysis
      (1) Estimation of external facilities requirements
      (2) Assignment of input/output storage
      (3) Bookeeping of allocation and utilization

- d. Executable statement translation
  - (1) Assembly of object program
  - (2) Assembly of data dictionary
  - (3) Assembly of error messages
  - (4) Insertion of library subprograms
- 2. Functions and structure of compiler
  - a. Size, location, and equipment requirements
  - b. Limitations on object machine configuration
  - c. General structure
    - (1) Number and name of passes
    - (2) Functions of passes
    - (3) Function and assignment of output tapes
    - (4) Function and location of input, master tape, and library
  - d. Program limitations
  - e. Operating system requirements
- 3. Operating procedures
  - a. Preparation of control cards
  - b. Assembly and preparation of run
    - (1) Assembly of card decks
    - (2) Loading of tapes, disk packs, etc.
    - (3) Console and equipment settings
  - c. Running of compilation
  - d. Processing, marking, and distribution of compilation output
    - (1) Card Decks
    - (2) Tapes and disk packs
    - (3) Listings
      - (a) Program listing
      - (b) Error listing
  - e. Debugging assistance
    - (1) Preparation by programmer
    - (2) Preparations by operator
    - (3) Input of test data
    - (4) Preparation for running
      - (a) Test data disposition
      - (b) Program master tape disposition
      - (c) Equipment and console settings
    - (5) Running
      - (a) Errors and error messages
      - (b) Stoppages and corrections
      - (c) Dumps
      - (d) Traces
    - (6) Debugging reports

D. Introduction to COBOL (COmmon Business Oriented Language)

- 1. History of the language development
  - a. CODASYL (Conference On DAta SYstems Languages)
  - b. COBOL history
  - c. COBOL processors
    - (1) Authority for standards
    - (2) Development by manufacturers
- 2. Purpose of language development
  - a. Create a common language
    - (1) Strong on facility to manipulate data

(2) Relatively independent of machines
(3) Less emphasis on computation
b. Create a language which reads like English
c. Ease programming

3. General characteristics
   a. Permits symbolic description of data environment
      (1) Facilitates many programmers and programs interacting with common data base
      (2) Enables data base changes without invalidating programs
   b. Permits symbolic description of machine environment and configuration
      (1) Defines transferability
      (2) Assists in modifying configuration
4. Language elements
   a. Character set
   b. Names and their rules
      (1) Data names
      (2) Procedure names
      (3) Condition names
      (4) Special names
   c. Vocabulary
      (1) Constants
      (2) Verbs
      (3) Operators
         (a) Arithmetic
         (b) Relational
         (c) Logical
      (4) Vocabulary restrictions
         (a) Key word lists
         (b) Optional words
   d. Syntax
      (1) Arithmetic expressions
      (2) Conditional expressions
         (a) Items to be compared
         (b) Relational conditions
         (c) Compound conditions
         (d) Contingency definitions
      (3) Statements and sentences
      (4) Paragraphs and sections
5. Data organization
   a. Definitions
      (1) Entries
      (2) Data elements
      (3) Records
      (4) Files
   b. Levels
      (1) File description level
      (2) Data item levels
6. Library
   a. Common data descriptions
   b. Common environment description
7. Program organization
   a. Program reference format
      (1) Sequence number
      (2) Program identification code

    - (3) Continuation indicator
- b. Data division
    - (1) Organization
        - (a) File section
        - (b) Working storage section
        - (c) Constant section
            - Independent
            - Grouped (optionally subscripted)
    - (2) File description entries
        - (a) File name, file level indicator
        - (b) Recording mode clause
        - (c) Block clause
        - (d) Label record clause
        - (e) Value clause
        - (f) Data record clause
        - (g) Copy clause
        - (h) Record size clause
    - (3) Record description entries
        - (a) Level number and name
        - (b) Size clause
        - (c) Class clause
        - (d) Usage clause
        - (e) Point location clause
        - (f) Sign clause
        - (g) Value clause
        - (h) Picture clause, numeric items
        - (i) Picture clause, alphabetic items
        - (j) Picture clause, alphanumeric items
            - Zero suppression characters
            - Insertion characters
            - Replacement characters
            - Reserved characters
        - (k) Editing clause
            - Blank clause
            - Justified clause
            - Synchronized clause
            - Occurs clause
            - Redefines clause
        - (l) Copy clause
    - (4) Constant definition, independent constant
        - (a) Level number
        - (b) Data name
        - (c) Scaling
            - Picture clause
            - Class and size clauses
        - (d) Value clause
    - (5) Table definition for subscripted names
        - (a) Definition of constant
        - (b) Redefines clause
- c. Procedure division
    - (1) General definition of procedures
    - (2) Program verbs, input/output
        - (a) OPEN
        - (b) READ
        - (c) WRITE

        - (d) CLOSE
        - (e) ACCEPT
        - (f) DISPLAY
      - (3) Program verbs, data manipulation
        - (a) MOVE
        - (b) EXAMINE
      - (4) Program verbs, arithmetic
        - (a) Rounding and truncation
        - (b) Size errors
      - (5) Program verbs, sequence control
        - (a) GO TO
        - (b) ALTER
        - (c) PERFORM
        - (d) STOP
      - (6) Program verbs, processor
        - (a) ENTER
        - (b) EXIT
        - (c) NOTE
    - d. Environment division
      - (1) Configuration section
        - (a) Source computer paragraph
        - (b) Object computer paragraph
          - Computer name
            - # Assigned by convention
            - # Specified memory and locations
            - # Specified complement of peripheral equipment
          - Assign object program clause
          - Memory size clause
        - (c) Special names paragraph
          - Condition names
          - Mnemonic device names
      - (2) Input/output section
        - (a) File control paragraph
        - (b) Input/output control paragraph
        - (c) Relationship to other divisions
    - e. Identification division

E. COBOL Processor
  - 1. Major functions of the processor
    - a. Check the source program for errors
      - (1) Format errors
        - (a) Word format
        - (b) Statement format
        - (c) Program format
      - (2) Content errors
        - (a) Computer equipment incompatibilities
        - (b) Key word errors
        - (c) Syntax errors
    - b. Compiler memory and space allocation requirements
    - c. Generate processing sequence
    - d. Create object program
  - 2. Functions and structure of the implemented compiler or compilers
    - a. Fast processors
    - b. Efficient object program processors

3. Operating procedures
   a. Preparation of master tapes
   b. Preparation of control cards
   c. Assembly and preparation for running
      (1) Assembly of card decks
      (2) Assembly of tape and disk packs
      (3) Loading of tapes and disks
      (4) Console and equipment settings
   d. Running of compilation
   e. Debugging assistance
      (1) Preparations by programmer
      (2) Preparations by operator
      (3) Input and assembly of test data
      (4) Preparation for running
         (a) Test data loading and disposition
         (b) Program master tape and tape loading
         (c) Equipment and console settings
      (5) Running
         (a) Errors and error messages
         (b) Stoppages and corrections
         (c) Dumps
         (d) Traces
      (6) Debugging reports

F. Practical Exercises (both FORTRAN and COBOL)
   1. Analysis of compilation requests
      a. Missing control cards in compilation requests
      b. Incompatibilities of request with source computer system
      c. Incompatibilities between requested object computer and the capabilities of the compiler or processor
      d. Incomplete or missing tapes and card decks, especially data
   2. Compilations
      a. Aborts due to computer and equipment errors
      b. Aborts due to control deck errors
      c. Aborts due to incomplete source programs or missing reference data (e. g., COBOL library not including name referenced by COPY clause)
      d. Successful runs with error listings
   e. Debugging
      a. Taking dumps at designated halts
      b. Tracing according to programmer's instructions
      c. Loading corrections and verifying loading

Teaching Aids

Since the primary purpose of this unit is to qualify the trainees as operators of the FORTRAN and COBOL compilers on their computers of specialization, the most important teaching aids are operator's manuals for those compilers and sample programs for analysis.

Instructor Reference Materials

Because of the differences among compilers used in various installations for various computers and configurations, the exact list of appropriate documents will not be specified here. The instructor should obtain the documents through the installation or installations on which he is planning to execute the laboratory exercises. The instructor will need the language descriptions for both FORTRAN and COBOL in the versions used with the installation compilers and processors together with the programmers guides and the documentation concerning the FORTRAN library subprograms available and of the COBOL library tape being used.

Suggested Trainee Activities

The trainees should improve their operators manuals through notes, prompting aids, etc., which will improve ther efficiency as operators. They must be carefully schooled not to rely on memory, however. Their activities should be channeled into efficient methods of using the guidance documentation provided.

Suggested Text Assignments

The levels of text materials appropriate for the trainees are the language description documents such as the IBM Systems Reference Library publications: Common Business Oriented Language (COBOL) General Information and IBM System/360 Basic FORTRAN IV Language rather than the programmer manuals on these languages or the self-instruction manuals designed for programmers. The trainees should make the operating guides for the compiler or processor their constant companions during this unit.

Note to Instructor

The instructor should obtain several examples of FORTRAN and COBOL programs. In the case of the COBOL programs, they should be associated with a data base located either on tape or disk or both. The programs should include both update an retrieval programs, and there should be a library tape with definitions of file and item descriptions used in the data base.

The instructor can waste much time developing and debugging his own programs. He is advised to obtain well-tested programs from the installation from which he will be renting the laboratory time. He should prepare program and data errors on cards and insert them into the program and data decks to obtain appropriate error printouts and erroneous results for diagnosis, illustrating the objectives of the lesson. The instructor will also find it useful to obtain source and object program listings reproduced to hand out to the trainees.

Unit IX

ADVANCED SYSTEMS

Training Time Classroom 24 hours; Laboratory 4 hours

Objectives

To introduce the trainees to the operation of computer installations which employ remote input/output devices and time sharing systems.

To acquaint the trainees with the organization and administration of such computer installations.

To acquaint the trainees with the economics of such systems, with their implications for operator responsibility, and with the apparent direction of development in the industry.

Unit Outline

A. General Survey
  1. Definitions
    a. Multiprogramming
    b. Multiprocessing
    c. Teleprocessing
    d. Conversational remote time sharing
    e. Foreground and background processing
  2. CPU characteristics
    a. Memory protection
      (1) Memory zones
        (a) Writing absolutely forbidden
        (b) Writing permitted to system executive or monitor program only
        (c) Writing permitted from variably specified memory zones
        (d) Reading permitted only on key match
      (2) Variable read and write keys settable from executive program region
      (3) Series of machine faults for violations of key controlled access procedures
    b. Rapid access mass memory (usually fast access disk)
      (1) Storage of symbionts (executive system subroutines which need not always be in core memory)
      (2) Storage of programs and data which are being exchanged either in background or foreground of time shared system
      (3) Optional where remote time shared operation not used
  3. Communication equipment requirements
    a. Modulator-demodulator (modem) terminals
    b. Communications processor and buffer
      (1) Access to multiple communication lines

    - (2) Switching
    - (3) Multiplexing-demultiplexing
    - (4) Parity checking
    - (5) Buffering
      - (a) Matching transmission line data rates to CPU data rates
      - (b) Temporarily storing lower priority messages
    - (6) Data compressions
  - c. Remote terminals
    - (1) Touch tone input
    - (2) Teletypwriters and similar printing keyboards
    - (3) Keyboards with CRT (cathode ray tube) displays
    - (4) Card readers
    - (5) Printers
    - (6) General purpose computers with peripheral equipment
    - (7) Voice output (audio response) units
- 4. General software characteristics
  - a. Complete operating systems for handling batch processing as background activity
  - b. Additional capability to handle time sharing by remote users in conversational mode as a foreground activity
  - c. Extensive automation of the diagnostic and corrective functions assigned in smaller systems to the operator
- 5. User's requirements for software
  - a. General commercial and administrative establishments
    - (1) Inventory control
    - (2) Personnel records
    - (3) Accounting, billing, and payroll
    - (4) Mailing list maintenance and mailing support
    - (5) Production planning and control
  - b. Retail establishments
    - (1) Sales records
    - (2) Inventory records and systems
    - (3) Wholesale buying records
  - c. Wholesale establishments
    - (1) Customer buying records
    - (2) Sales force, route, and prospect information and follow-up
    - (3) Order and delivery information and shipping
  - d. Professional establishments
    - (1) Information and document storage and retrieval
    - (2) Computation
    - (3) Programmed instruction
- 6. Software packages operating under time sharing executive control and available at remote consoles
  - a. On-line compilers and processors for versions of higher order languages such as FORTRAN, COBOL, and BASIC
  - b. On-line data storage and retrieval processors
  - c. On-line mathematical analysis packages
    - (1) Statistical analysis packages
    - (2) Linear and dynamic programming packages
    - (3) Network analysis packages
  - d. On-line engineering design packages
    - (1) Electrical and electronic circuit and network analysis
    - (2) Civil engineering packages

- (a) Cut and fill computation
- (b) Stress analysis
- (3) Mechanical engineering applications
- e. General management packages
  - (1) PERT (Program Evaluation Review Technique), PERT-Cost, and CPM (Critical Path Method)
  - (2) SIMSCRIPT and other simulation and planning tools
  - (3) Management and war games
  - (4) Programmed instruction builders
- 7. System monitor advances
  - a. Extended diagnostics and automatic correction of errors
  - b. Provision for remote recognition of users and authentication
  - c. Provisions for efficient exchange of programs in both foreground and background
- 8. Changed role of the operators -
  - a. Elementary machine functions
    - (1) Start-up
    - (2) Manual configuration control
  - b. Management of job scheduling in background processing stacks
  - c. Authentication and verification of users in foreground
  - d. Supervision of requested tape and disk changes, loading and unloading
  - e. Coordination with library
  - f. Maintenance of use records and reports
  - g. Loss of many error correction functions to the executive or to the equipment maintenance or program maintenance personnel
  - h. Shift of operator station from main console to Terminal 0

B. Typical Configuration

- 1. Central installation
  - a. CPU with large memory (usually 64K words or more)
  - b. Large fast access mass storage (drum or disk)
  - c. Multiple tape transports (twelve or more)
  - d. Normal complement of card equipment and printers
  - e. Data terminal equipment
    - (1) Modems (Modulators-demodulators)
    - (2) Communications computer
- 2. Ancillary installations providing remote back-up capability more or less identical to the above
- 3. User installations
  - a. Keyboard and printer (teletypewriter)
  - b. Buffered terminal equipment connected to input/output equipment
    - (1) Keyboards
    - (2) Display devices
    - (3) Card equipment
    - (4) Printers
    - (5) Local general purpose computers (large and small)
    - (6) Data phones

C. Economic Considerations

- 1. Capital value of installations
  - a. Building

    b. Computing equipment
    c. Other equipment
2. Operating costs, fixed and variable
    a. Debt service
    b. Salaries and services
    c. Utilities and supplies
    d. Other administrative costs
3. Income
    a. Charges prorated on the basis of CPU time used
    b. Detailed charges
        (1) Actual CPU time used
        (2) Connection charges
        (3) Storage device charges
        (4) Telephone line charges (may be billed direct by telephone company)
        (5) Terminal equipment rental (may be rented direct from manufacturer or from leasing company)
4. Profit analysis
    a. Total fixed costs
    b. Total variable costs
    c. Typical competitive charges
    d. Minimum work level for profitable operation
    e. Causes of losses
        (1) Equipment faults
            (a) Terminal problems
            (b) Communication line problems
            (c) CPU or mass storage failure
        (2) Programming errors
            (a) Executive monitor errors
            (b) General programming packages
            (c) User errors
        (3) Operator errors
            (a) Incorrect responses to console messages
                - Denying access to authorized user
                - Permitting access to unauthorized user
                - Destroying data or programs
            (b) Incorrect settings
            (c) Mounting wrong tapes or disks
    f. Costs and duration of failures
        (1) Mechanical and electrical failures
            (a) Losses to service bureau
            (b) Losses to client
        (2) Programming errors
            (a) Losses to service bureau if operating system or service packages in error
            (b) Losses to client
                - From service bureau failures
                - From user errors
        (3) Operator errors
            (a) Losses to service bureau
                - Loss of revenue
                - Loss of client satisfaction
            (b) Losses to client
                - Inconvenience and loss of time
                - Loss of security

- Loss of data and results

C. Demonstration
   1. Tour of facility and demonstration of equipment and library
   2. Explanation of organization
   3. Explanation of forms and procedures
   4. Discussion of experience

Teaching Aids

Configuration charts and illustrations of a variety of installations with time-sharing capability (e. g., IBM System/360 Model 67, UNIVAC 1108, GE 435, RCA Spectra 70/46, or SDS Sigma 7) and detailed pictures of the communications terminal equipment and commonly used consoles should be obtained through local manufacturer's representatives.

Instructor Reference Materials

The instructor should obtain from the manufacturers the latest operator's manuals on the time-sharing systems and the user's manuals. From these he can extract information on the types of program packages available to him and the types of diagnostics which are provided to the programmer at the remote location. The instructor should pay special attention to identifying for the trainees those diagnostics which represent functions with which he has become familiar in the previous units of the course. If there is a service bureau in the area which offers time-sharing services, it should be relied on to provide current information and assistance.

Suggested Trainee Activities

The trainees should be encouraged during this unit to design an organization chart for a computer service bureau and to write job descriptions for the employees. They should also be encouraged to work out job control forms. This can best be done as group projects with the groups comparing their results during Unit X, Data Processing Organization and Management.

Suggested Text Assignments

The trainees should read FORTUNE, September 1967, with special attention to the description of the time-sharing executive program and to the description of time-shared operations.

Note to the Instructor

If there are local service bureaus offering remote conversational time-sharing service, or local representatives of national organizations, the instructor should attempt to obtain from them cost sheets, accounting methods, and any forms which they have developed for internal administration. Since this is a highly competitive field, reliable and revealing information is jealously guarded. In this context, if possible, the advisory committee could have a remote terminal demonstrated in the classroom as an illustration of the growing trend in the industry to use these on-line devices.

Unit X

DATA PROCESSING ORGANIZATION AND MANAGEMENT

Training Time Classroom 16 hours; Field trips 3 hours

Objectives

To enhance and clarify the trainee's understanding of the structure, origin, motivation, and operating methods of institutions which may be their employers.

To clarify for the trainees the interdependence of function between data processing organizations and the groups in governmental and commerical institutions which they support.

To review and organize the trainees' appreciation of the investment, operating costs, and responsibilities of data processing facilities and organizations.

Unit Outline

A. Organization of Business
  1. Top management
    a. Board of directors
      (1) Members
        (a) Owners or owners' elected representatives
        (b) Company officers
      (2) Decision procedures and organization
      (3) Functions
        (a) Call company into existence and bear responsibility
        (b) Approve mergers, acquisitions, and dissolution
        (c) Avoid bankruptcy and divide profits (dividends)
        (d) Issue stock shares and approve stock ownership
        (e) Appoint officers and remove them
        (f) Review and approve budgets, borrowing, loans
        (g) Review and approve operating rules
        (h) Enunciate policy and delegate authority
    b. Company officers and their functions
      (1) Titles and their meaning
        (a) Chairman of the Board
        (b) President
        (c) Chief executive officer
        (d) Vice president
        (e) Treasurer
        (f) Secretary
        (g) General manager (chief operating officer)
      (2) Functions
        (a) Agree to contracts

(b) Interpret and carry out policy
  - Personnel
  - Marketing
  - Production
  - Purchasing and warehousing
  - Financial management and accounting

2. Business structure
   a. Principal forms
      (1) Sole proprietorship
      (2) Partnership
      (3) Limited liability corporation
         (a) Profit distributing
         (b) Not-for-profit
   b. Capitalization
      (1) Source of initial capital
         (a) Investment
            - Founders
            - Interested parties
            - Public stock issue
         (b) Loans
            - Time and effort (deferred salary, etc.)
            - Secured money
      (2) Source of subsequent capital
         (a) Profits and deferred payments
         (b) Bond issues
         (c) Secured loans
         (d) Stock offerings (controlling interest problems)
3. Personnel management
   a. Planning
      (1) Size of required work force
      (2) Personnel qualifications
      (3) Future personnel requirements
   b. Recruitment and training
      (1) Recruitment
         (a) Advertising
         (b) Agencies
         (c) Referrals
      (2) Interviewing and selection
         (a) Testing
         (b) Interviewing and discussions with supervisors
         (c) Reference checks
      (3) Training and career development
   c. Administration
      (1) Placement, transfer, separation and promotion
      (2) Salary reviews
      (3) Fringe benefit packages
         (a) Retirement benefits
         (b) Insurance
         (c) Participation in profits
   d. Labor relations
4. Marketing and sales
   a. Market planning, product planning
      (1) Long range planning
      (2) Short range planning
   b. Operations

      - (1) Market intelligence gathering
      - (2) Sales strategy and operations
      - (3) Advertising campaigns
- 5. Production management
  - a. Production engineering
  - b. Production planning and scheduling
    - (1) Work force
    - (2) Materials and supplies
    - (3) Subcontracts
  - c. Supervision
- 6. Inventory management
  - a. Facility planning
    - (1) Capacity projections
    - (2) Design and layout
  - b. Facility operation
    - (1) Cataloging
    - (2) Accounting
    - (3) Service and item handling
  - c. Operation evaluation and improvement
    - (1) Data sampling
    - (2) Simulation and analysis
- 7. Libraries and data banks
  - a. Document libraries
    - (1) Acquisition
    - (2) Cataloging
    - (3) Circulation
  - b. Data stores
    - (1) Original and reproduced documentation
    - (2) Derived information
    - (3) Classification and storage
    - (4) Updating and purging
    - (5) Retrieval and editing
- 8. Research and development
  - a. Technological forecasting
  - b. Basic research and exploration
  - c. Developmental engineering
  - d. Testing and evaluation
- 9. Contract administration
  - a. Contract development and negotiation
  - b. Performance monitoring
  - c. Patent review, filing, and defense (including other proprietary data)

B. Non-scientific Data Processing in Business and Government
- 1. Characteristics of application areas
  - a. Detailed repetitive data handling tasks
  - b. Extensive numerical tasks
  - c. Quick response time requirements
  - d. Errors intolerable
- 2. Examples of application areas
  - a. Accounting
    - (1) Inputs
      - (a) Time cards for employees
      - (b) Sales slips
      - (c) Stock debits

    - (d) Orders for merchandise
    - (e) Accounts payable
    - (f) Checks
  - (2) Outputs
    - (a) Trial balances
    - (b) Account summaries
    - (c) Bills
    - (d) Statements
    - (e) Checks
- b. Personnel records and management
  - (1) Inputs
    - (a) Interview forms
    - (b) Test scores
    - (c) Biographic information
    - (d) Reports of personnel actions
    - (e) Efficiency and evaluation reports
  - (2) Outputs
    - (a) Address lists
    - (b) Rosters of organizations and personnel
    - (c) Salary and skill profiles and summaries
    - (d) Vacation schedules
    - (e) Review and promotion lists
    - (f) Vacancy summaries and personnel requisitions
- c. Information systems
  - (1) Inputs
    - (a) Master coding forms for accessions
    - (b) Information coding forms
    - (c) Text extracts
    - (d) Dictionaries and glossaries
    - (e) Retrieval requests
  - (2) Outputs
    - (a) Printed indices of employees
    - (b) Accession lists
    - (c) Information summaries: hires, quits, turnover rates
    - (d) Subject bibliographies
    - (e) Card indices
    - (f) Displays on cathode ray tubes for instantaneous access
- d. Production control
  - (1) Inputs
    - (a) Production control pattern and networks
      - Line of balance
      - Critical path
    - (b) Step and phase requirements
      - Materials
      - Facilities
      - Personnel
      - Lead time
    - (c) Milestone reports
    - (d) Slippage predictions
  - (2) Output
    - (a) Work orders and schedules
    - (b) Requisition and delivery schedules
    - (c) Facility schedules and assignments

- (d) Projections and management summaries
- e. Sales and inventory management
  - (1) Inputs
    - (a) Sales data
      - Route assignments and schedules
      - Customer data
      - Visit and follow-up reports
      - Sales records
    - (b) Purchases
      - Purchase descriptions and product specifications
      - Order and delivery schedules
      - Contracts and franchises
    - (c) Market information (competitor data)
    - (d) Guidelines
      - Service criteria
      - Quality criteria
      - Cost and term criteria
      - Lease-purchase criteria
  - (2) Outputs
    - (a) Route and prospect lists
    - (b) Purchase schedules
    - (c) Supplier lists and product catalogues
    - (d) Service summaries and supplier reference and experience data
    - (e) Handling costs and experience
  - (3) Inventory methods
    - (a) LIFO, FIFO
    - (b) Pricing criteria - cost vs. replacement values
- 3. Higher order system applications
  - a. Application areas
    - (1) Computation support to scientific research
    - (2) Engineering computations
    - (3) Simulation and planning systems
    - (4) Education
      - (a) Administrative aids
      - (b) Computer administered instruction and testing
  - b. Types of system
    - (1) Degree of interaction
      - (a) Batch process packages
      - (b) Interactive, conversational packages
      - (c) Combination background and foreground packages
    - (2) Content and discipline
      - (a) Compilers (FORTRAN, ALGOL, etc.)
      - (b) Simulation systems (GPSS, SIMSCRIPT, etc.)
      - (c) Statistical analysis systems
      - (d) Mathematical programming systems

- C. Data Processing Organization
  - 1. Kinds of organization
    - a. Open shop computer
    - b. Closed shop computer
      - (1) In-house service bureau
      - (2) Commercial service bureau
    - c. Service capability

    - (1) Batch processing service
    - (2) Remote input/output service
    - (3) Conversational time sharing service

2. Job descriptions in data processing
   - a. Analysts
     - (1) Problem and applications finding and sales
     - (2) Problem solution
     - (3) Programming solution of small problems
     - (4) Supervision of programmers for larger jobs
   - b. Programmers
     - (1) Solving less complex problems
     - (2) Transforming solutions into running programs
     - (3) Program testing
   - c. Operators
     - (1) Aiding programmers in using operating systems
     - (2) Running the computer and programs
     - (3) Aiding programmers during testing
     - (4) Supervision of equipment
     - (5) Performing routine service jobs
       - (a) Manipulating card decks
       - (b) Storing data on tapes and disks
       - (c) Duplicating data and programs
       - (d) Listing tapes and card decks
   - d. Keypunch operators
     - (1) Assisting programmers by punching program decks
     - (2) Punching data decks
     - (3) Assisting operator by punching control cards
     - (4) Verifying cards
   - e. Clerks
     - (1) Work order records and schedules
     - (2) Library records
3. Clients (outside the organization)
   - a. Acquisition
     - (1) Information and publicity
     - (2) Referrals from satisfied clients
     - (3) Additional requests from satisfied clients
     - (4) Direct sales by analysts, possibly by salesmen
   - b. Obligations
     - (1) Full service contracts
     - (2) Partial support service contracts and work orders
       - (a) System analysis and design
       - (b) Programming
       - (c) Keypunching
       - (d) Data bank manipulation and maintenance
       - (e) Computer time and access
     - (3) Correctness of operations
     - (4) Promptness of machine availability
     - (5) Timeliness of delivery
     - (6) Safeguarding of programs and data
       - (a) Unauthorized access
       - (b) Loss and destruction
4. Operating costs and revenues
   - a. Space rental
     - (1) Reception area
     - (2) Management office

    - (3) Keypunch area
    - (4) Clerical office
    - (5) Computer room
    - (6) Supply space
    - (7) Library for tape, disks, and cards
  - b. Equipment rental or purchase and amortization
    - (1) Keypunches and verifiers
    - (2) Sorter
    - (3) Computer and peripheral equipment
    - (4) Data terminal equipment
    - (5) Special auxilliary devices
      - (a) Card bursters
      - (b) Collators and decollators
      - (c) Strippers, folders, and mailing equipment
    - (6) Typewriters
    - (7) Duplicators and printing equipment
    - (8) Storage cabinets
    - (9) Desks, tables, and chairs
  - c. Supplies
    - (1) Stationery supplies
    - (2) Punched cards
    - (3) Magnetic tapes and disk packs
    - (4) Printer paper, ribbons, tapes
    - (5) Specialized forms
  - d. Services
    - (1) Printing
    - (2) Art work and composing
    - (3) Computer and equipment maintenance
    - (4) Correspondence and mailing
    - (5) Telephone and communication lines
    - (6) Utilities and cleaning
    - (7) Advertising
    - (8) Courier and delivery
    - (9) Collection
    - (10) Legal services
    - (11) Business consulting
    - (12) Personnel consulting and employment
    - (13) Insurance
      - (a) Liability
      - (b) Workman's compensation
      - (c) Social security
      - (d) Health and hospitalization
  - e. Direct labor
    - (1) Administrative
    - (2) Operations
    - (3) Sales
  - f. Revenue
    - (1) Cost reimbursements
    - (2) Fees
  - g. Prices
    - (1) Total costs
    - (2) Expected income
    - (3) Profit
    - (4) Competition
- 5. Examples of organizational structure and function allocation

Teaching Aids

Examples of organization charts from local industry and data processing groups and institutions.

Instructor Reference Materials

Barnett, C. C., Jr., and Associates. The Future of the Computer Utility.
Folts, Franklin E. Introduction to Industrial Management.
Higginson, M. V. Managing with EDP: a Look at the State of the Art.
Lickert, R. New Patterns of Management.
Murphy. J. M. Handbook of Job Facts.
Parkhill, D. F. The Challenge of the Computer Utility.
Rubenstein, A. H. and Haberstroh, C. J. Some Theories of Organization.

Suggested Trainee Activities

Trainees should be divided into working groups to obtain quotations on rentals and sales prices for various kinds of equipment needed by data processing organizations. The instructor should arrange for interviews between trainees and some of the business advisory committee members (or others whom they may recommend) for further insights and data concerning business costs, the needs for services, and the nature of business relationships. The students should prepare and present reports to the class.

Since the collection of this data will require considerable time, the assignments should be made not later than the 19th week. The instructor should assist the trainees in setting up appointments and should pay special attention to warning the trainees about the passage of time. He and the trainees should try to coordinate the interviews with the cooperative work experience schedule, and with field trips.

A class project could be very effectively developed around the management of a data processing problem. As an example, consider the development of a master list of transactions which are to be updated monthly. Volume of input, time constraints, equipment requirements, document flow and all the inter-related activities inherent in such an undertaking should provide the trainee with a much firmer grasp of the overall value and costs of a data processing organization. It should also heighten his sense of responsibility and his awareness of the costs (both in time and money) of inattention and inaccuracies.

Unit XI

JOB EXPERIENCE, GUIDANCE, COUNSELING AND EVALUATION

Training Time | Classroom 55 hours

Objectives

To aid the trainee toward successful personal adjustment to the job.

To reinforce his efforts through evaluating the work experience.

To guide trainees toward maximum levels of achievement and to indicate possible pathways for advancement.

Unit Outline

A. Job Orientation
  1. Job relationships
    a. Relationship with supervisor
      (1) Supervisor responsibilities
        (a) Attendance of work force
        (b) Productivity
        (c) Performance of jobs on schedule
        (d) Preventing infringement of rules
          - Abuse of sick leave
          - Abuse of personal leave
        (e) Prevention of loss or damage to equipment or inventory
        (f) Physical well-being of work force
        (g) Enforcement of safe practices
        (h) Correction of poor work habits
        (i) Review of performance and recommendations for salary increases
        (j) Recommendations for firing
        (k) Scheduling of vacations
        (l) Recommendations for training
        (m) Recommendations for promotion
      (2) Supervisor privileges
        (a) Greater freedom of movement
        (b) Higher pay and fringe benefits
        (c) Right to assign less enjoyable tasks to others
    b. Relationship with employer
      (1) Employer responsibilities and obligations
        (a) Safety of employees
        (b) Adequate instruction of employees
        (c) Payment of employees for services
        (d) Provision of working facilities and equipment
        (e) Compliance with laws on working conditions and compensation

    - (f) Contribution to unemployment compensation funds and to social security funds
    - (g) Opportunities for continued employment
    - (h) Opportunities for promotion
  - (2) Employee responsibilities and obligations
    - (a) Performance of work assigned as directed
    - (b) Conformity with work rules as agreed between employer and either employee or union
    - (c) Protect and conserve plant facilities, equipment and inventory
    - (d) Protect employer's business and trade secrets
    - (e) Protect and defend employer's reputation
    - (f) Informing employer through supervisor when work assignments
      - Unacceptable
      - Violate agreements
      - Violate law
      - Unsafe
      - Unclear
  - (3) Employee's rights
    - (a) Right to clear instructions
    - (b) Right to refuse work and resign or quit subject to agreed on rules and convention (e. g., 2 weeks notice of intention to quit)
    - (c) Right to safe and wholesome working conditions or to adequate recompense
    - (d) Right to be informed of hazards
    - (e) Right to two weeks notice or severence pay (normally two weeks pay) if employment is terminated except for employee's violation of rules or conduct
    - (f) Right to adequate compensation
    - (g) Right to training for job
  - (4) Employer's rights
    - (a) Right to abridge or abrogate employee's rights and privileges for misbehavior
    - (b) Right to two weeks notice if employee wishes to quit
    - (c) Right to loyalty of employee
    - (d) Right to receive the fruits of employee's best efforts in accordance with employment understanding
- c. Relationship with fellow employees
  - (1) Positive factors
    - (a) Mutual cooperation and support
    - (b) Friendliness, confidence, and trust
    - (c) Honesty and reliability
    - (d) Unselfishness
  - (2) Negative factors
    - (a) Gossiping
    - (b) Dishonesty and shirking
    - (c) Unreliability
  - (3) Threat and competition
    - (a) Recognition of the problem
    - (b) Methods for handling it

- d. Relationship with customers and clients
    - (1) Honesty vs. misrepresentation
    - (2) Honesty vs. discretion
    - (3) Helpfulness vs. commitment
    - (4) Contractual obligations vs. proposals
- 2. Personal relations
  - a. Setting personal goals
    - (1) Assessing desired life style
    - (2) Assessing ability and limitations
    - (3) Assessing desired working environment
    - (4) Assessing desired income levels
    - (5) Assessing family development goals
    - (6) Assessing alternate careers
    - (7) Setting sequence of career decision points and family decision points
    - (8) Arranging check list of goals for personal guidance
    - (9) Arranging review of goals and counseling
  - b. Job hunting
    - (1) Selecting immediate job goals
      - (a) Job categories
      - (b) Job titles and salary range
      - (c) Necessary qualifications
      - (d) List of possible employers
      - (e) Desired range of job change dates
      - (f) Confidential prospecting
      - (g) Announced prospecting
    - (2) Obtaining job-pertinent background information
      - (a) Educational requirements
      - (b) Experience requirements
      - (c) Other requirements
      - (d) Salary ranges
    - (3) Preparing a resume
      - (a) Name
      - (b) Address and phone number
      - (c) Age, birthplace, and social security number
      - (d) Job and professional objectives
      - (e) Experience (starting with most recent)
        - Dates
        - Job title
        - Employer, address, division, supervisor
        - Work assignments
          - Nature of work
          - Degree of supervision, responsibility, initiative, etc.
          - Salary progress on jobs (entry and termination information
          - Accomplishments
      - (f) Military career, rank, and current status
      - (g) Education
        - School
        - Location
        - Years attended
        - Degree, certificate, etc.
        - Course of study
      - (h) Honors, awards, etc.

- (i) Marital status
- (j) Non-work oriented activities
  - Sports and hobbies
  - Clubs and civic activities
- (k) List of special qualifications for the job
- (4) Preparing applications
  - (a) Federal Form 171
  - (b) Commercial application forms
- (5) Letters of application
  - (a) List of addresses of potential employers
  - (b) Correct person in firm
  - (c) Correct spelling, title, and address
  - (d) Reason for writing
  - (e) Source of referral
  - (f) Reason for wanting the position
  - (g) Request for an interview
  - (h) Address, phone, times when can be reached
- (6) References
  - (a) Request for permission
  - (b) Character and personal references
  - (c) Teachers
  - (d) Coworkers
  - (e) Former supervisors
- c. Interview
  - (1) Dress and appearance
  - (2) Confirming interview time and place
  - (3) Promptness
  - (4) Attitude
  - (5) Questions
    - (a) Personal aspirations
    - (b) Job aspirations
    - (c) Relationship with past supervisors
    - (d) Job experience
    - (e) Preferences
    - (f) Dislikes
    - (g) Trap questions on salary and availability
- d. Motivation and performance
  - (1) Setting of goals and schedule for achieving them
  - (2) Setting standards of personal performance
  - (3) Measuring and assessing accomplishments
  - (4) Self-criticism
  - (5) Invited criticism
  - (6) Self-improvement program

3. Disciplinary actions and separations
   - a. Nature of job relationships
     - (1) Purpose of job
     - (2) Purpose of the compensation
     - (3) Expectations of the employer
     - (4) Expectations of the employee
     - (5) Job as a contract
   - b. Permanence of job relationship
     - (1) Conditions of a job
       - (a) Need for the work
       - (b) Resources to pay for the work

- (c) Structure to make a job (supervision)
- (2) Causes of failure
  - (a) Need for the work
    - Job completed
    - Client or customer dissatisfied with person, quality of work, etc.
    - Failure to meet job standards
  - (b) Resources
    - Essential materials not available
    - Inadequate facilities
    - Inadequate personnel
    - Inadequate funds and financing
  - (c) Structure
    - Qualified supervisor not available
    - Adequate training not available
    - No contract for work
  - (d) Attitude of employee
  - (e) Attitude of supervisor
- (3) Alternatives
  - (a) Lay-offs, reductions-in-force
    - Meaning in terms of rehiring
    - Meaning in terms of seniority and perceived standing in work force
    - Meaning in terms of job applications
    - Assistance from company in finding new job
  - (b) Disciplinary actions
    - Probation
    - Suspension
    - Firing
      - Meaning in terms of eligibility for rehiring
      - Meaning in terms of job applications
      - Meaning in terms of recommendations and references

- B. Guidance and Counseling
  - 1. Job assignment
    - a. Interview and selection
    - b. Introduction to future working environment
      - (1) Brochures
      - (2) Visit to plant and plant interview to discuss the jobs available
      - (3) Introduction to training supervisor
  - 2. Discussion of work experience - weekly problems; insights
  - 3. Review of personal goals and plans

- C. Evaluation (Final Week)
  - 1. Review of cooperative work experiences
  - 2. Assessment of adjustment
  - 3. Inventory of problems and methods adopted for handling them
    - a. Work-related problems
      - (1) Skill related problems
      - (2) Problems with supervisor
      - (3) Problems with coworkers

        (4) Problems with employer
    b. Non-work-related problems
        (1) Financial problems
        (2) Family problems
        (3) Community problems
4. Evaluation of performance and progress
5. Final counseling interview

Instructor Reference Materials

Adams, James Frederick. Counseling and Guidance.

Bellak, Leopold, and Small, Leonard. Emergency Psychotherapy and Brief Psychotherapy. This should be compared with discussions by L. Breger and J. L. McGaugh, Psychological Bulletin, 63, 338-58 (1965), the reply of the authors, Ibid., 65, 170-173 (1966), and the critique by S. Rachman and H. J. Eysenck, Ibid., 65, 165-169 (1966).

Bennett, Margaret Elaine. Guidance and Counseling in Groups.

Borrow, Henry (ed.). Man in a World at Work.

Levinson, Harry. Emotional Health: In the World of Work.

Menninger, William Claire, and Levinson, Harry. Human Understanding in Industry: A Guide for Supervisors.

Ullman, Leonard P., and Krasner, Leonard (eds.). Case Studies in Behavior Modification.

Ullman, Leonard P., and Krasner, Leonard (eds.). Research in Behavior Modification: New Developments and Implications.

Patterson, Cecil Holden. Theories of Counseling and Psychotherapy.

Suggested Trainee Activities

The trainees should be given as a project, early in the course, the task of obtaining organization charts of the groups with which they are working in the cooperative work experience program. During Unit XI, they should compile job descriptions of their fellow workers, and develop a written profile of what they expect as a salary program for the unit within which they will be working. This should include their own salary expectations for several years, with consideration of their relative salary and skill and responsibility positions within the unit. Discussion of these reports can assist them in setting more positive and realistic goals for themselves.

Note to the Instructor

In this unit the instructor should avoid as far as possible the usual classroom atmosphere, and should create an informal arrangement with the atmosphere of a discussion group. Rather than attempting to teach the content of the outline in subunit A, the instructor or counselor should try to elicit the material from the trainees themselves, to assist them in achieving a basic understanding of their future working environment, and to help them digest daily experiences in the cooperative work experience program. One of the principal objectives is to make them aware of the problems they encounter and to help them arrive at an understanding of how to handle such problems in a constructive manner.

In this subunit the first ten to twelve hours will be directed towards orienting the trainee towards the pending cooperative occupational training experience. Role playing, simulated interviews, and similar devices should be stressed to overcome individual shortcomings and to allay nervousness in interview situations. Practice in filling out applications, preparing resumes, and general letters of application should also be stressed.

For Subunit B, if a psychologist is not available, it is advisable for the instructor to have access to a consulting psychologist to aid in resolving some of the problems which may arise.

Counseling continues through the course, and trainees should be encouraged to discuss experiences freely.

Unit XII

COOPERATIVE WORK EXPERIENCE

Training Time Laboratory 260 hours

Objectives

To provide the trainee with practical experience in a computer installation.

To introduce the trainee to a work situation in which he can develop good working habits and attitudes.

To provide the trainee with opportunity to achieve some dexterity and expertise in the skills taught in Units I through IX.

To provide the trainee with earned income during his training.

General Guidelines

A. Skill Development

1. Keypunch.

While the trainee will have been introduced to the keypunch and verifier in Unit I, the time alloted and the objectives of the course do not permit him to have attained the accuracies or speed expected of keypunch operators. His formal training was complete by the end of Week 1 of the course. At the beginning of his Cooperative Work Experience (Week 5 of the course) the trainee can be expected to punch individual cards when no trained keypunch operators are available; however, it would be inadvisable to place the trainee under production pressures expected of a professional keypunch operator.

2. Sorter, Collator, Interpreter.

In addition to minimal keypunching skills, the trainee will enter the Cooperative Work Experience program with familiarity with the basic EAM, gained in Week 2 during Unit I. This should enable him to operate under close supervision the Sorter, Collator, and Interpreter. He should be able to perform major and minor sorts, sort into numerical order, and alphabetize card decks. He will be able to perform simple wiring tasks on the Collator but not on the Interpreter. He can be expected to run sequence checks and merge decks; but he should be given close supervision and guidance to avoid discouragement. The trainee should be given tasks during Weeks 4, 5, and 6, the first three weeks that the trainee spends in Cooperative Work Experience, which are appropriate to these skills.

3. Peripheral equipment.

During the first three weeks on Cooperative Work Experience (Weeks 4 to 6 of the course) the trainee will have his first introduction to peripheral equipment in the form of card readers and printers. Beginning with Week 7 (his fourth week on Cooperative Work Experience) the trainee can be expected to assist the operator of card-oriented computers at the card reader or printer. He should be given careful explanations and close supervision and guidance at the start. The supervisor should assure himself that the trainee knows the differences between the equipment on which course instruction was given and the equipment in the Work Experience installation. The trainee can be expected to perform such tasks as feeding cards into the reader, changing paper and ink ribbons on the printer, and duplicating carriage tapes on the UNIVAC 1004 printer. The trainee should be able to clear mechanical feed problems on the card reader and printer, but should not be permitted to take corrective action except with the guidance of the supervisor.

4. Console operation.

The trainee will be qualified on two computers by classroom and laboratory work during the course, but the models may not be identical to the models in the Work Experience installation. The trainee will have completed his training on the card-oriented computer for which he will receive training by the end of Week 9 of the course. This training will include the use of the card utility packages provided by the manufacturer for the third generation card-oriented computers. The trainee learning the UNIVAC 1004 will have the ability to wire boards. The trainee during classroom and laboratory work will have solved elementary problems of designing control decks for utility packages on the card-oriented third generation computers or will have designed solutions to elementary 1004 wiring problems, depending on his course content. He will have solved some elementary problems in sequence checking, sequence numbering, sorting and merging, and listing cards; however, the supervisor should not expect the trainee to perform even elementary programming problems in the Work Experience installation without careful explanation and guidance. After careful guidance, the trainee should be given the opportunity to oversee the console during job runs beginning in Week 10 of the course. The supervisor should insist that the trainee read and familiarize himself with the manuals and notes specifying the operating procedures for the equipment on which he will be working.

Between the 10th and 18th Weeks of the course, the trainee is receiving classroom and laboratory introduction to the major third generation computer for which he is being trained. During this period in the Work Experience installation, the trainee should be encouraged to acquaint himself with the peculiarities of the installed equipment and with the instructions and operating procedures which apply. From the 15th to the 18th Weeks the trainee is being introduced to operating systems and receiving instruction and practice in handling both console operations and peripheral equipment. By the end of this period the trainee should have become familiar with most of the internal procedures of the Work Experience installation, including the library organization, handling of work orders, labeling and handling of magnetic tapes and disk packs, and so forth.

Beginning in Week 16 or 17 the trainee should be given experience in handling the peripheral equipment of the major computer and in monitoring the console operations. By the end of Week 18 he will have run some programs using the operating system and will have learned how to take dumps, trace loops and branches, and set up run control cards. He will also have received some instruction and practice in clearing halts due to card and printer problems. His instruction will all have been in the batch processing modes. By the end of Week 20 the trainee will have completed instruction in running FORTAN and COBOL compilations and his training as an operator will have been completed. The remaining weeks will be filled with other material of professional importance; but at this point the trainee begins to spend half-days every day at the Work Experience installation rather than the previous intermittent schedule. It is desirable after Week 20 for the trainee to have become familiar with all phases of operation in the installation and to be assigned specific tasks for which he will be responsible. If the trainee has proven himself, and the supervisor expects to retain him in the installation after graduation, the trainee will be available regularly from this point on except for Week 26, the week of graduation.

B. Scheduling.
The master schedule for the course assumes that the trainees will report to their Work Experience installation supervisors for regular half-day assignments every second day between Weeks 5 and 20. During this period they are receiving instruction which is directly related to the duties which they can be expected to perform as computer operators. During this period they could be considered in an apprenticeship status. In some installations they might be given regular assignments helping the librarian with card decks, tapes, disk packs, run records, and so forth, but should be exposed to the equipment under direct supervision as much as possible.

The master schedule for the course assumes that the trainees will spend half-days every working day at the installation between Weeks 21 and 25. During this period they can be treated as regular members of the installation work force, since they will have completed most of their formal instruction including laboratory practice.

The supervisor should attempt by the end of Week 20 to have determined whether he feels he can retain the trainee on his work force and thereafter assign the trainee a job related to the one he will have after graduation. The supervisor should be aware that the trainee will not report for work, however, during Week 26 of the course.

C. Activities.
Computer operations do not really lend themselves to on-the-job training because of the substantial theoretical knowledge needed by the trainee. His cooperative work experience is, therefore, not on-the-job training. However, the trainee is undergoing a learning experience and requires close supervision, continual instruction, and correction. The supervisor should be particularly careful in demanding close attention by the trainee to procedural rules established for the guidance of the computer installation personnel.

One of the objectives of the work experience program should be to condition the trainee to sustained attention to detail. From the beginning the trainee should be made to understand and adhere to the installation standards of accuracy, cleanliness, and neatness. The trainee should be expected to perform the work assigned him with precision. He must be made to understand that the less prestigious tasks which he will perform at the beginning can not be treated more lightly than the tasks performed by the console operator.

The trainee should receive a thorough grounding in the conventions used by the installation for marking and identifying cards, tapes, and disk packs. It is important for him to spend some time working in the library to handle incoming work orders, manuscript sheets, and card decks, and to exercise some responsibility for assembling, logginh, and delivering outgoing card decks, printouts, and so forth. Contact with the clients of the installation can be expected to impress the trainee with the importance of care and accuracy even under pressure.

D. Problems.

The integration of young or disadvantaged persons into a working group often brings with it special problems. They may be over-confident of their ability to handle unforeseen technical problems. The disadvantaged (both economically and educationally) tend to be suspicious of their supervisors, expecting to be exploited, and may become defensive. It is therefore particularly important for the supervisor to build up the self-confidence of the trainee and to encourage good relations with other members of the work force. All need to acquire the sense of belonging to a competent team. The trainee must acquire good work habits as well.

If the supervisor perceives problems with the trainee which seem to be creating difficulties and which he may not be able to handle in a constructive manner, he should feel free to call on the instructor or guidance counselor for assistance. They may be able to address the problem with the trainee, for example, in group counseling sessions, as part of the activities of Unit XI, Job Orientation, Guidance, Counseling, and Evaluation.

E. Meetings Between Technical Instructor and Job Supervisor.

Schedules and ad hoc meetings between the supervisor and the classroom or laboratory instructor can be of much benefit. Behavior problems or technical problems discovered by either the instructor or the supervisor can be addressed by the other without a direct rebuke to the trainee. Corrective feed-back to the classroom work and additional practice beyond the laboratory work can be arranged as needed. The instructor should take the initiative to meet with the job supervisor as early as possible during the work experience and should make himself available for further consultation as the need arises.

Supervisor Reference Materials

Borrow, Henry (ed.). Man in a World at Work.

Menninger, William Claire, and Levinson, Harry. Human Understanding in Industry: A Guide for Supervisors.

Unit XIII

COMMUNICATION SKILLS

Training Time Classroom 100 hours

Objectives

To identify the deficiencies of trainees who have not achieved tenth-grade level reading, writing, and oral communication skills.

To provide remedial work for those whose skills are below the tenth-grade level.

To improve the skills of all trainees, with emphasis on efficient reading and acceptable writing and speech, particularly as they are necessary for success as a computer operator.

To orient the trainees in the forms and conventions of communication in the worlds of business and government administration.

To provide experience in using technical terms.

Unit Outline

A. Reading Improvement
- 1. General definition of the problems of reading
  - a. Recall of methods by which class members learned to read
    - (1) Number taught phonics
    - (2) Number taught words by sight
    - (3) Kinds of reading practice
    - (4) Relationship between reading and spelling
  - b. Common bad reading habits
    - (1) Reading word by word
    - (2) Following words with the finger
    - (3) Subvocalization and lip movements
    - (4) Retracing
  - c. Diagnosis of sources of difficulty
    - (1) Lack of reading practice
    - (2) Improper training and habits of reading
    - (3) Lack of concentration
  - d. Corrective actions
    - (1) Participation in reading course throughout training program
    - (2) Following a private, scheduled program of reading every day
- 2. Objectives of reading training
  - a. Improve reading speed
  - b. Improve reading comprehension
  - c. Increase ability to read with discrimination
- 3. Improved concentration ~~and~~ efficiency

- a. Reading for main ideas
- b. Ignoring minor details
- c. Setting consumption goals
    - (1) Amount of time to be devoted to reading
    - (2) Amount of material to be covered
- d. Setting and maintaining reading pace
- e. Trying gradually more difficult material
- f. Keeping mind from wandering
- g. Testing comprehension
- h. Applying improved reading techniques to all reading

4. Improved reading techniques
    - a. The reading process
        - (1) Fixation and eye movements
        - (2) Size of view (number of words)
        - (3) Number of stops per line
        - (4) Rapidity of eye movement
        - (5) Length of line and reading speed
    - b. Perception training
        - (1) Tachistoscope and substitutes
        - (2) Exercises to widen field of perception
            - (a) Practice on shorter and longer groups of digits
            - (b) Practice on shorter and longer words and phrases
        - (3) Exercises for speed of perception
    - c. Blocks to rapid reading
        - (1) Regressions
            - (a) Nature of problem
            - (b) Causes and effects
            - (c) Exercises to reduce regressions
            - (d) Constant vigilance
        - (2) Vocalization and lip movements
            - (a) Nature of the problem
            - (b) Causes and effects
            - (c) Remedies
        - (3) Inner speech
            - (a) Early associations of sounds and meanings
            - (b) Assistance in memory and understanding
            - (c) Substitute for vocalization or lip movements
            - (d) Excuse for not concentrating on the ideas in the material being read
            - (e) Interposing an unnecessary intermediate step to understanding
            - (f) Block to immediate grasp of meanings of words and phrases on sight
            - (g) Block to aggressive search for main message

B. Improved Vocabulary

1. Importance of vocabulary
    - a. Limit on access to ideas and information
    - b. Limit on ability to handle ideas and information
    - c. Measure of achievement
    - d. Means toward or barrier to effective communication
2. Use of dictionary
    - a. Practice in finding words
    - b. Structure of dictionary entries

        c. Key to pronunciation
        d. Key to meaning of word derivations
        e. Special glossaries
            (1) Abbreviations
            (2) Gazetteer
            (3) Names of persons
        f. Interpreting definitions
    3. Use of encyclopedia
        a. Difference between dictionary and encyclopedia
        b. Practice in selecting between dictionary and encyclopedia
        c. Practice in finding words and using index
        d. Structure of entries and meaning of cross-references
        e. Specialized dictionaries, encyclopedias, and glossaries
    4. Vocabulary building methods
        a. Use of vocabulary building manuals
        b. Reading with dictionary
        c. Reading with notebook of new words
        d. Reading with attention to new words in context
        e. Copious reading of material by good writers and special authorities
    5. Designing and implementing a personal vocabulary-building program
        a. Selecting methods and materials
            (1) List of books
            (2) List of magazines
            (3) Newspaper reading regime
        b. Designing a schedule
        c. Establishing and taking tests
        d. Reviewing and measuring progress

C. Reading Improvement Program
    1. Schedule
        a. Classroom exercises
        b. Home reading schedule
        c. Practice materials
            (1) Rapid reading practice manual
            (2) Selection of newspaper materials
            (3) Selection of magazines
            (4) Selection of other recreational reading
            (5) Selection of educational materials
    2. Guidelines
        a. Pacing reading as fast as possible
        b. Reading to grasp author's meaning, thinking, and central idea
        c. Concentrating on extracting the main idea while reading (thinking while reading)
        d. Avoiding unnecessary regressions (avoiding letting concentration lapse)
        e. Skimming material which does not contribute to understanding
            (1) Reading first and last sentences of a paragraph
            (2) If paragraph is not part of main idea, skipping it to next paragraph

D. Business Communication
  1. Language skills
    a. Standard English, where expected
      (1) Major radio and TV networks
      (2) Schools and colleges
      (3) Business and government
      (4) Communication among educated people
      (5) Communication with foreigners
    b. Regional and ethnic dialects
      (1) Social class indicators
      (2) Indicators of educational level
      (3) Indicators of attitude or perceived signals
        (a) Willingness to work
        (b) Desire to communicate
        (c) Pride in origins
        (d) Rejection and hostility to surroundings and associates
    c. Diction
      (1) Enunciation
        (a) Voice placement
        (b) Resonance
        (c) Projection
        (d) Clarity
      (2) Pronunciation
        (a) Dropping consonants (examples)
          - Fac' - fact, nex' - next
          - Yiel' - yield
          - goin' - going
          - W'at - what
        (b) Dropping vowels and syllables
        (c) Adding letters and syllables
        (d) Pronouncing silent letters
        (e) Rearranging sounds (receration for recreation)
    d. Use of dictionary
      (1) Sounds and symbols
      (2) Accent
      (3) Variations and preference
    e. Importance
      (1) Pleasing to customers
      (2) Good first impression in business community
      (3) Speed of communication
      (4) Reducing misunderstanding
  2. Grammar
    a. Importance
      (1) Clarity of meaning
      (2) Self-corrections on thinking
    b. Sentence structure
      (1) Definition of a sentence
      (2) Definition of subject
      (3) Definition of predicate
      (4) Simple and compound subjects and predicates
    c. Verbs
      (1) Definition
      (2) Forms
        (a) Regular

    - (b) Irregular
    - (c) Infinitives
    - (d) Linking or being verbs
    - (e) Transitive
    - (f) Intransitive
  - (3) Principal parts
- d. Nouns
  - (1) Definition
  - (2) Plural forms
    - (a) Regular
    - (b) Ending in "y"
    - (c) Ending in "o"
    - (d) Ending in "f" or "fe"
    - (e) Vowel changes
    - (f) Multiple plurals
    - (g) Use of apostrophe
    - (h) Plurals of compound nouns
    - (i) Missing plural forms
    - (j) Grammatical plurals
    - (k) Foreign plural forms
  - (3) Possessive
    - (a) Use of apostrophe
    - (b) Omission of apostrophe
    - (c) Possessive of a compound
    - (d) Joint of separate possession
    - (e) Possessive with a gerund
- e. Pronouns
  - (1) Definition
  - (2) Cases and uses
    - (a) Nominative
    - (b) Objective
    - (c) Possessive
  - (3) Self-ending pronouns
  - (4) Predicate nominative
  - (5) Complement of the infinitive "to be"
  - (6) Restrictive appositives
  - (7) Comparison
  - (8) Pronouns in compounds
  - (9) Use of "who" and "whom" in questions
  - (10) Predicate agreement, number and person
    - (a) Simple subject problems
      - Verbs ending in "s" and "es"
      - Collective nouns, singular and plural
      - "A number of" - "the number of", singular and plural
      - "There is" - "there are"
      - Indefinite words as subjects
    - (b) Compound subject problems
      - Subjects joined by "and"
      - Subjects joined by "or" or "nor"
    - (c) Relative pronoun clauses
- f. Adjectives
  - (1) Definition
  - (2) Comparison
    - (a) Methods of forming comparitives

    - (b) Methods of forming superlatives
    - (c) Absolute adjectives
  - (3) Special problems
    - (a) "Those" and "them"
    - (b) "Kind(s) of" and "sort(s) of"
    - (c) "This" and "these"
    - (d) "That" and "those"
- g. Adverbs
  - (1) Definition
  - (2) Comparison
  - (3) Special problems
    - (a) "Sure" - "surely"
    - (b) "Real" - "really"
    - (c) "Good" - "well"
  - (4) Double negatives
- h. Prepositions
  - (1) Definition
  - (2) Comparison
  - (3) Special usages
- i. Conjunctions
  - (1) Definition
  - (2) Coordinate
  - (3) Correlative
  - (4) Subordinate
  - (5) Special usages

3. Spelling
- a. Importance
  - (1) Expected by business readers
  - (2) Interpreted as proof of reliability, care, and accuracy
  - (3) Bad spelling requiring excuses and killing sales and confidence
  - (4) Chances of misunderstandings
- b. Reasons for problems
  - (1) English usage as consensus with no supreme authority - lexicographers
  - (2) Influence of word origin
  - (3) Influence of word history
- c. General rules
  - (1) Singular
    - (a) Redoubling of final consonants
    - (b) "ei" and "ie" rule
  - (2) Plural formations
  - (3) Special classes of problem
    - (a) Homonyms and near homonyms
    - (b) Prefixes
      - "Ante-" and "anti-"
      - "En-" and "in-"
      - "Dis-" and "des-"
      - "For-", "fore-", and "four-"
    - (c) Suffixes
      - Dropping silent "-e"
      - Retaining silent "-e"
      - Doubling final consonant
      - Treatment of final "-y"

- "-sede", "-ceed", "-cede"
- "-tion", "-sion", "-cion", "-cian", "-tian", "-sian", "-xion"
- "-able", "-ible"
- "ise", "-ize", "-yze"
- "-ance", "-ence", "-ense", "-ant", "-ent"
- "-ar", "-er", "-or"
- "-ary", "-ery"
- "-ous", "-ious", "-eous"

(d) Other troublesome words

4. Punctuation
    - a. Capitalization rules
    - b. Use of commas
    - c. Use of semicolons
    - d. Use of period
    - e. Use of exclamation point
    - f. Use of question mark
    - g. Use of quotation marks
    - h. Use of brackets, parentheses, and dashes
    - i. Use of suspension points
    - j. Use of hyphen
    - k. Use of apostrophe
    - l. Indentation
    - m. Compound words
    - n. Italicizing and underlining
    - o. Abbreviations
    - p. Numerals

E. Expository Writing
1. Purpose and use
    - a. Communicating instructions
    - b. Explaining a problem
    - c. Proposing a solution
    - d. Making a report
2. Deciding what to say
    - a. Subject and title
    - b. What will the readers already know
    - c. What new information the readers need
    - d. In what order the readers should read the material
3. Outlines and drafts
    - a. Getting ideas on paper
    - b. Organizing ideas into an outline
    - c. Grouping ideas into paragraphs and sections
    - d. Use of scissors and paste
    - e. Revising for an audience and trying it out
    - f. Correcting grammar, spelling, and punctuation
    - g. Correcting for good usage
        - (1) Repeated words
        - (2) Looking up questionable meanings
        - (3) Improving word order
        - (4) Checking pronouns for antecedents
    - h. Improving the order in which ideas are presented
    - i. Eliminating extraneous ideas
    - j. Improving transitions
    - k. Tightening up paragraphs

4. Final form
    a. Medium
        (1) Typing or handwritten
        (2) Kinds of paper
        (3) Neatness and penmanship
    b. Format
        (1) Cover, title, author, date
        (2) Table of contents
        (3) Text
            (a) Margins
            (b) Paragraphs
            (c) Subtitles (location, underlining, capitalizing)
            (d) Footnotes (location and identification)
            (e) Bibliography
            (f) Appendices
        (4) Proofreading
        (5) Final review
        (6) Delivery
            (a) Personal delivery
            (b) Letter of transmittal
            (c) Selling the text

F. Oral Communications
    1. Types of speaking
        a. General conversation
        b. Oral presentations and briefings
        c. Exposition and training
        d. Telephone conversation
        e. Working with groups
    2. Successful speaking and oral reports
        a. Preparation, knowing the facts
        b. Outline
            (1) Determining purpose of talk
            (2) Analyzing audience
            (3) Selecting relevant information and subjects
            (4) Organizing material
        c. Arranging material for audience
            (1) Arousing interest in subject
            (2) Introducing the subject
            (3) Explaining the subject
            (4) Summarizing the main points
        d. Illustrative material
            (1) Stories and examples
            (2) Pictures and charts
        e. Practice
            (1) Practicing alone and with a mirror
            (2) Practicing before an audience which knows to whom the talk is to be given
            (3) Asking for and discussing criticisms
            (4) Accepting criticism and advice
            (5) Revising talk and repeating practice
        f. Special cautions while giving talk or report
            (1) Proper standing
            (2) How loud to talk, how to project voice
            (3) Handling nervousness

        (4) Recognizing and handling mannerisms
        (5) Watching the time
        (6) Keeping contact with listeners
        (7) Using and handling questions

3. General conversation
    a. Knowing your field
    b. Being interested in the listener or partner
    c. Using stories
    d. Paying attention to names
        (1) Getting the name correct at the start
        (2) Using the name
        (3) Memory aids and tricks
        (4) Importance of remembering names as sign of interest in people
    e. Speaking clearly
    f. Fitting manner of speaking to conversation partners
4. Telephone conversation
    a. Manner of answering the phone
    b. Speaking into the phone correctly
    c. Making notes on messages
    d. Telephone courtesy
    e. Getting all the pertinent information before hanging up
5. Practical exercises
    a. Giving a talk or report
    b. Acting out a situation involving a client
    c. Handling a complaint
    d. Handling telephone conversations

Teaching Aids

Where possible and needed, the instructor should make arrangements for a tape recorder to aid the trainees in correcting their speech habits, enunciation, pronunciation, voice control and so forth.

Instructor Reference Materials

Hart, Mark. 4-Star Collegiate Word Power.

Lewis, Norman. How to Read Better and Faster.

Stewart, Marie M., and others. Business English and Communication.

Stewart, Marie M., and others. Business English and Communication. Workbook.

Suggested Trainee Activities

Each trainee must prepare and report on his concurrent activities in reading, vocabulary improvement, spelling practice, writing, and speaking. Each trainee should have a schedule for his non-classroom time in which he allocates requisite time for each of these tasks. He should keep a written record of his goals and accomplishments. The instructor should have a copy of the trainee's schedule. The objective of the trainee's reporting should be to provide him with some external controls which can reinforce his own efforts at building self-discipline.

Special remedial programs should be arranged for trainees with special problems. Where possible the trainees should be organized into small self-help groups with minimal supervision by the instructor, but with his active encouragement. Where volunteer help in remedial work can be obtained, it should be encouraged, but only to the extent that it can be carefully guided and supervised by qualified professionals in remedial work.

Each trainee should be assigned a subject early in the course on which he will give an oral report. It is desirable that the subject be related to the course work including the work experience unit. Related outside topics may be useful with some of the more able trainees.

Where possible the instructor should weave his discussion and examples around data processing topics and situations, and the trainee should be encouraged to do the same. The practical applications of the material being studied and their direct relationships to the world of work often provide a positive motivation to the disadvantaged trainee.

Each trainee should be issued a copy of each of the volumes listed under Instructor Reference Materials above. They will provide the backbone of his efforts. The workbook will aid classroom exercises. The books for vocabulary building and reading improvement can be used in classroom exercises and can also contribute to the trainee self-help programs.

Unit XIV

MATHEMATICS SKILLS

Training Time Classroom 100 hours

Objectives

To provide the trainee with facility in the basic mathematics used in business and data processing.

To encourage the development of additional mathematical skills, especially algebra, in those with greater aptitude.

Unit Outline

- A. Fundamental Arithmetic Processes
    - 1. Number systems
        - a. Decimal numbers
            - (1) Symbols
            - (2) Operations, definitions
                - (a) Addition
                - (b) Subtraction
                - (c) Multiplication
                - (d) Division
        - b. Binary numbers
            - (1) Symbols
                - (a) Written
                - (b) Mechanical
                - (c) Electronic
            - (2) Operations
                - (a) Addition
                - (b) Subtraction
                - (c) Multiplication
                - (d) Division
            - (3) Special notations
                - (a) Identity element of addition
                - (b) Identity element of multiplication
        - c. Other numbering systems
            - (1) Octal
                - (a) Symbols
                - (b) Operations
                - (c) Relationship to binary
            - (2) Hexadecimal
                - (a) Symbols
                - (b) Operations
                - (c) Relationship to binary
        - d. Practice in conversions
    - 2. Practice with the decimal system
        - a. Addition and subtraction
            - (1) Practical applications

        - (a) Maintenance of banking records
        - (b) Inventory records
        - (c) Accounting for time on a computer
    - (2) Improvement in technique
        - (a) Mental addition of two, three, and four place numbers
        - (b) Tricks in adding single columns
        - (c) Checking techniques
            - Adding in the opposite direction
            - Horizontal addition
            - Base-10 parity checking
- b. Multiplication
    - (1) Basic procedure
        - (a) Multiplying multiple integer numbers
        - (b) Multiplying when multiplier ends in zero
        - (c) Multiplying when multiplier contains zero
    - (2) Short cuts
        - (a) Multiplying by a two digit number
        - (b) Multiplying by a three digit number
    - (3) Checking
        - (a) Estimate range within which number must lie
        - (b) Alternate methods of multiplication
        - (c) Invert multiplier and multiplicand
        - (d) Divide product by either multiplier or multiplicand
- c. Division
    - (1) Basic procedures
        - (a) Long division
        - (b) Short division
        - (c) Special cases
            - Dividing by multiples of 10
            - Dividing by 25 or 50
    - (2) Checking
- d. Applications
    - (1) Conversion of dimensions
    - (2) Fractions on the number base
        - (a) Decimal fractions
        - (b) Binary fractions
        - (c) Octal and hexadecimal fractions
        - (d) Tricks with magnitude
    - (3) Rate problems
- e. Fractions
    - (1) Addition and subtraction
    - (2) Multiplication and division
    - (3) Conversion between fractions on an arbitrary denominator and those on the number base
        - (a) Conversions to decimals and back
        - (b) Conversions to binary and back
        - (c) Conversions decimal to binary
    - (4) Aliquot parts
    - (5) Percentage
        - (a) Finding base, percentage, and rate
        - (b) Distribution of overhead
        - (c) Pricing and discounts
        - (d) Commisions and salaries

- (e) Mark-up and profit
- (f) Inventory estimation
- (g) Depreciation

B. Practice Problems

- 1. Data processing estimates
  - a. Estimating costs based on time charges
    - (1) Keypunching problems
    - (2) EAM estimates
      - (a) Sorting problems
      - (b) Collating and listing
      - (c) Processing problems
  - b. Estimating operating expenses
    - (1) Capital outlay, service, and amortization problems
    - (2) Personnel related overhead and salaries
    - (3) Cost increase projections
  - c. Establishment of price structure
    - (1) Estimating revenue potential
    - (2) Problems involving estimate work load, costs, and desired profits
- 2. Interest
  - a. Simple interest
  - b. Compound interest
  - c. Notes and bank discounts
  - d. Mortgage loans
  - e. Installment sales
  - f. Annuities
  - g. Sinking funds
  - h. Amortization
- 3. Insurance
  - a. Fire insurance
  - b. Insurance premiums
  - c. Insurance adjustments
  - d. Life insurance and annuity settlment options
- 4. Payroll
  - a. Payroll and job charges
  - b. Payroll deductions
    - (1) Social security
    - (2) Unemployment compensation
    - (3) Medical insurance
    - (4) Federal income tax withholding
    - (5) State income tax withholding
    - (6) Voluntary deductions
- 5. Taxes
  - a. Sales taxes
  - b. Property taxes
  - c. Personal income taxes
  - d. Corporate income taxes
- 6. Financial statements
  - a. Income statements
  - b. Comparative income statements
  - c. Balance sheets
  - d. Financial statement ratios
    - (1) Working capital ratio
    - (2) Accounts receivable to net sales ratio

        - (3) Net income to net sales ratio
    - 7. Discounts
        - a. Trade
        - b. Cash
    - 8. Mark-up
        - a. Selling price
        - b. Cost price
    - 9. Commissions
    - 10. Depreciation methods
    - 11. Statistics and graphs

- C. Elementary Algebra
    - 1. Sets and set relationships
        - a. Definition and construction of sets
        - b. Set relations
        - c. Variables
        - d. Cartesian product sets
    - 2. Equations, inequalities, and functions
        - a. Equations
        - b. Two types of inequality
        - c. Solution sets
        - d. Combinations of inequalities and equations
        - e. Equations and inequalities in two or more variables
        - f. Functions
    - 3. Important sets
        - a. Counting numbers
            - (1) The set of counting numbers (W)
            - (2) Operations in the set W and the question of closure
                - (a) Addition
                - (b) Subtraction
                - (c) Multiplication
                - (d) Division
                - (e) Raising to a power
                - (f) Extracting a root
            - (3) The set of counting numbers and zero (W*)
            - (4) Operations in the set W*
            - (5) Operation laws
                - (a) Commutative law
                - (b) Associative law
                - (c) Distributive law
        - b. Integers
            - (1) The set of integers (J)
            - (2) Operations in the set J
            - (3) The graph of J X J
            - (4) Additive inverses
            - (5) Identity element of addition
        - c. Rational numbers
            - (1) The set of rational numbers (F)
            - (2) Operations in the set F and the question of closure
                - (a) Addition
                - (b) Subtraction
                - (c) Multiplication
                - (d) Division
                - (e) Raising to a power
                - (f) Extracting a root

            - (3) Identity elements and inverses
        - d. Real numbers
            - (1) The set of real numbers (R)
            - (2) Operations in the set of real numbers and the question of closures
    - 4. Polynomials
        - a. Introduction to the set of polynomials P
        - b. Operations in the set P_X
            - (1) Addition
            - (2) Subtraction
            - (3) Multiplication
                - (a) Monomials
                - (b) Binomials
                - (c) Polynomials
            - (4) Raising to a power
            - (5) Division
                - (a) Monomials
                - (b) Polynomials
                - (c) Factoring
    - 5. Polynomial equations and inequalities
        - a. 1st degree equations
            - (1) Solution by addition
            - (2) Solution by multiplication
        - b. Inequalities
        - c. Equations of 1st degree in two or more variables
            - (1) Graphs of solution sets
                - (a) Slope
                - (b) Coordinate intercepts and roots
                - (c) Slope-intercept form
                - (d) Equation of a graph
            - (2) Simultaneous equations
                - (a) Solution by addition or subtraction
                - (b) Solution by substitution
        - d. Inequalities in two variables
        - e. Quadratic equations
            - (1) Roots of simple equations
            - (2) Equivalent equations
            - (3) Roots by factoring
            - (4) Graphs
            - (5) Solutions by completing the square
            - (6) Quadratic formula
    - 6. Set operations
        - a. Union
        - b. Intersection
        - c. Complement
        - d. Laws
            - (1) Commutative laws
            - (2) Associative laws
            - (3) Distributive laws
            - (4) De Morgan's laws
        - e. Intersection of solution sets of equations

- D. Probability and Statistics
    - 1. Probability elements
        - a. Occurances

        - (1) Permuations
        - (2) Combinations
        - (3) Probability
        - (4) Probability of two independent events
            - (a) Or
            - (b) And
    - b. Mathematical expectation
    - c. Empirical probability
    - d. Binomial distribution
        - (1) Binomial theorem
        - (2) Application to probability
- 2. Elements of statistics
    - a. Measures of central tendency of data
        - (1) Arithmetic mean
        - (2) Median
        - (3) Mode
    - b. Grouping of data
        - (1) Frequency grouping
            - (a) Quartiles
            - (b) Percentiles
            - (c) n-tiles
        - (2) Class grouping
        - (3) Deviations from the mean
            - (a) Average deviation
            - (b) Standard deviation
        - (4) Common distributions
            - (a) Binomial distribution
            - (b) Normal distribution

Instructor Reference Materials

Hayden, Dunstan. Algebra One.

Mayor, John R. Contemporary Algebra.

Rice, Louis A. and others. Business Mathematics for Colleges.

Suggested Trainee Activities

Trainees should be grouped by mathematical skill level, divided into an appropriate number of sections (two or more), and taught in these groopings, with an emphasis in the lower levels on acquiring the basic mathematical skills as quickly as possible. They should be encouraged to practice correcting their weak points with each other.

Note to the Instructor.

Groups of trainees which show ability to move through subunits A, Fundamental Arithmetic Processes, and B, Practice Problems, should be advanced quickly to subunit C, Elementary Algebra. How far these students can progress should be limited by their ability to absorb mathematical information and concepts and acquire mathematical skills rather than by the arbitrary content of the course. For some trainees programmed materials may be used to good advantage.

Each trainee should be issued a copy of the Workbook by Rice and others and of Business Mathematics for use as a basic reference. The texts by Hayden and Mayer, indicated as instructor references, may be issued on a selective basis as trainees show their readiness to move into the more advanced subunits.

GLOSSARY

This glossary derives many of its definitions from Executive Office of the President, Bureau of the Budget. Automatic Data Processing Glossary, published in 1962. The selected term definitions have been substantially revised and updated, and new terms have been added for this course guide.

abort, to terminate the processing of a computer program before it has reached it's own termination as designed by the programmer.

accumulator, (1) the register and associated equipment in the computer in which arithmetic and logical operations are performed; (2) a unit in a digital computer where numbers are totaled; related to adder.

adder, a device which forms the sum of two numbers, usually in the accumulator.

address, (1) an identification represented by a name, label, or number, for a register or location in storage; (2) a number used in symbolic coding in conjunction with a relative address, i.e., the address generated by the compiler, assembler, or operating system.

address, absolute, an address giving the exact location in storage where a code or number is located or to be written.

address, base, a number which indicates an approximate address and which is summed with one or more other numbers, e. g., an index, to obtain the absolute address.

address, indexed, an address that is to be modified or has been modified by summing with an index.

address, indirect, an address in a computer instruction which gives the address of the address of an operand.

algebra, Boolean, a branch of mathematics and logic dealing with operators such as AND, OR, NOT, EXCEPT, IF . . . THEN, and so forth and permitting calculation of classes and propositions and useful both in programming and in the design of electronic calculation circuits; named after George Boole, English mathematician (1815-1864).

algorithmic, pertaining to a calculation process which leads to the solution of a problem in a finite number of steps.

alphanumeric, a contraction of alphabetic-numeric, usually referring to a set of characters including both alphabetic and numeric symbols.

analog, the representation of numerical quantities by means of physical variables such as length, rotation, voltage, resistance, or brightness; contrasted with digital.

analysis, systems, (1) examination of an activity, procedure, method, technique, or business to determine what must be accomplished and how the necessary operations may be performed; (2) a synonymn for operations research.

analyst, a person skilled in the definition of and the development of techniques for solving problems, especially techniques applicable to computers.

arithmetic, fixed point, (1) a method of calculation in which operations take place in an invariant manner, and in which the computer does not consider the location of the radix (decimal or binary)point; contrasted with floating point; (2) a type of arithmetic in which the operands and results of all arithmetic operations must be scaled so as to have a magnitude between fixed values.

arithmetic, floating point, a method of calculation which automatically accounts for the location of the radix (decimal or binary) point; this is usually accomplished by handling the number as a signed mantissa times the radix raised to an integral exponent which is carried with the number; the decimal number +88.3 might be written as +.883/+2 ($+.883 \times 10^{-2}$); and the binary number -.0011 as -.11/-2 ($-.11 \times 2^{-2}$); contrasted with fixed point arithmetic.

arithmetic, double precision, assignment of two computer words per arithmetic data address and appropriate computation routines to carry additional precision in calculation.

asynchronous, descriptive of the internal timing of components of a computer such that the beginning of one operation is initiated on the termination of another operation.

assembler, a computer program which operates on symbolic programs to produce machine operation code and address assignments.

buffer, an internal portion of a data processing system, usually a data storage device or memory element, linking components with either different data rates or independent access times.

byte, (1) a generic term indicating a specific portion of a string of digits, e. g., an 8-bit or 6-bit byte; (2) a group of binary digits usually operated on by the computer as a unit.

call in, to transfer control of a digital computer temporarily from a main routine to a subroutine which is inserted in the sequence of calculating operations to fulfill a subsidiary purpose.

capacity, channel, (1) the maximum number of binary digits or other elementary digits which can be handled in a particular channel per unit of time; (2) the maximum possible information transmission rate through a channel at a specified error rate, usually given as bits per second.

capacity, storage, the number of elementary pieces of information that can be contained in a storage device, usually given as a number of bits, bytes, characters, or computer words.

card, control, a card which contains input data or parameters for a specific application of a general routine or program.

card, detail, one of a set of cards in a data system and representing an entry in a file subordinate to a master card.

card, 80-column, a punch card with 80 vertical columns of punch positions representing 80 characters; each column is divided into two sections, one with character positions labeled zero through nine, and the other labeled eleven (11 or X-punch) and twelve (12 or Y-punch); the X and Y positions are also called zone punches.

card, master, a card containing fixed or indicative or specification information for a group of cards; it is usually the first card in the group.

card, 90-column, a punch card with 90 vertical columns representing 90 characters; each card has 45 columns of twelve positions each; the upper six rows are numbered one through forty-five and the lower six are rows forty-six through ninety; the ninety column card is punched with round holes in contrast to the rectangular holes of the 80-column card; the 90-column card and its handling equipment are still found in some UNIVAC installations, but it has been largely replaced by the 80-column card and its equipment which are manufactured by the IBM Corporation.

card-programmed, (1) the capability of being programmed by punched cards; (2) the capability of performing sequences of calculating operations according to instructions contained in a stack of punched cards which are read into the calculator one or more at a time.

card, punch, a card of exact standard size, shape, thickness, stiffness, and smoothness suitable for punching mechanically under electro-mechanical control; the punched holes are sensed either by wire brushes, mechanical fingers, photoelectric cells, or photodiodes.

center, data processing, an installation consisting of one or more computers together with peripheral equipment and staff; it usually serves either the general market or a specific set of customers.

chad, a small piece of paper tape or punched card removed in the punching process.

channel, (1) a path along which information may flow; (2) one or more parallel tracks treated as a unit, e. g., on magnetic tape; (3) a path for electrical communication; (4) a band of frequencies used for radiated communication.

character, (1) one of a set of elementary symbols such as those on the keys of a typewriter which are used for input to or output from data processing equipment; (2) the pattern of bits or electric signals used to represent a character within a computer or on a channel.

character, binary coded, one element of a character set expressed as a configuration of binary digits.

character, illegal, a combination of bits not accepted by the machine and detected by the computer as an error.

chart, flow, a graphic representation of the steps in a process.

chart, logical flow, a graphic representation of the sequence of operations and decisions involved in solving a problem; it is one of the methods of documenting the logical processes implemented by a computer program.

check, a process of partial or complete testing of the correctness of machine operations, the existence of prescribed conditions within the computer, or the correctness of the results produced by a program; a check may be made by an engineer, automatically by the equipment, or by a program.

check, dump, a check of the accuracy of a data transmission made by retransmitting the data to the sender who then compares it to the original transmission.

check, marginal, a preventive maintenance procedure of the reliability of the circuits in a computer by varying voltages and observing for resulting errors.

check, modulo N, (1) check that makes use of a check number that is equal to the remainder of the desired number when divided by N; e. g., in a modulo 4 check, the check number will be 0, 1, 2, or 3 and the remainder of A when divided by 4 must equal the reported check number B; otherwise an equipment malfunction has occurred; (2) a method of verification by congruences, e. g., casting out nines.

check, parity, a summation check in which the binary digits in a character, byte, or word are added modulo 2 and the sum checked against a single, previously computed parity digit; synonymous with odd-even check.

check, residue, any modulo N check.

check, summation, a check in which groups of digits are summed, usually without regard for overflow, and that sum checked against a previously computed sum to verify that no data has been changed; compare with totals, hash, and totals, control.

check, transfer, a check which verifies that information is transferred correctly from one place to another; it is usually done by comparing each character transferred at a different time or by a different route.

check, validity, a check based on known limits on given data or results; e. g., a calendar month greater than 12.

clear, to erase the contents of a storage device by replacing the contents with blanks or zeros.

clock, (1) a master timing device which provides the basic sequencing pulses in the circuitry of a computer; (2) a register which always contains the current time.

code, (1) a system of symbols for communication; (2) a system of symbols for representing data or instructions in a computer or tabulating machine; (3) to translate a problem solution into a computer program; (4) a machine language program.

code, binary, a coding system in which the encoding of any data is done through the use of the binary digits 0 and 1 and in which the position represents a power of two.

code, biquinary, a two part code in which each decimal digit is represented by the sum of the two parts, one of which has the value of zero or five and the other the (quinary) values zero through four; the abacus and soroban both represent numbers in biquinary code.

Decimal	Binary	Biquinary	Interpretation
0	0000	0 000	0+0
1	0001	0 001	0+1
2	0010	0 010	0+2
3	0011	0 011	0+3
4	0100	0 100	0+4
5	0101	1 000	5+0
6	0110	1 001	5+1
7	0111	1 010	5+2
8	1000	1 011	5+3
9	1001	1 100	5+4

code, baudot, a binary code with five bits per character (called five-level code) used in teletype transmission.

code, column-binary, a code used with punched cards in which successive bits are represented by the presence or absence of punches on contiguous positions in successive columns as opposed to rows; column-binary code is widely used in connection with 36-bit word computers where each group of three columns is used to represent a single word.

code, computer, (1) a system of combinations of binary digits used by a given computer; (2) a repertoire of instructions.

code, direct, a code which specifies the use of actual computer command and address configurations; usually refers to sections of a program in a language such as FORTRAN or COBOL in which the programmer was not satisfied with the object code generated by the compiler or processor and wished to control the machine operation directly.

code, error correcting, an error detecting code in which the error recording system identifies which bit is wrong.

code, error detecting, a code in which errors produce forbidden combinations.

code, excess-three, a binary-coded decimal representation of numbers in which each digit is represented by its own value plus three; this code is useful in decimal arithmetic because it produces an automatic carry signal on addition of two numbers; e. g., 4 + 7 = 11 would be written in simple binary coded decimal notation as 0100 + 0111= 1011 (in binary notation) which must be converted to 1 0001 by a separate operation to return to the excess-three notation; when the number is stored in excess-three notation, the carry appears automatically as 0111 + 1010 = 1 0001 complete with its carry, which result is then stored as 0100 0100.

Decimal Code	Binary Coded Decimal (BCD)	Excess-three Code (XS-3)
0	0000 0000	0011 0011
1	0000 0001	0011 0100
2	0000 0010	0011 0101
3	0011	0110
4	0100	0111
5	0101	1000
6	0110	1001
7	0111	1010
8	1000	1011
9	0000 1001	0011 1100
10	0001 0000	0100 0011

code, mnemonic operation, a computer operation code in which the digits are alphabetic abbreviations of the operations: e. g., ADD for the addition command, CLR for clear storage, and PRT for print.

code, symbolic, a code which expresses programs in a language which does not refer to absolute locations of storage in the computer.

collate, to merge two or more ordered sets of data or cards in order to produce one or more ordered sets which still reflect the original ordering relations; the collation process is the merging of two sequences of cards, each ordered on some mutual key, into a single sequence ordered on the mutual key.

comment, an expression written into a program which reminds the programmer of his original intention, informs the user of the program where particular processes are performed, and serves as a documentation technique; the comment is ignored by the assembler, compiler, or processor.

compatibility, equipment, the characteristic of computers by which one computer may accept and process data prepared by another computer or may use peripheral equipment made by a different manufacturer.

compile, to produce a machine language routine (or sometimes a symbolic program) from code written in a source language (usually a problem or procedure oriented language); the compilation is normally produced to run on a specific hardware configuration and under a specific monitor system.

compiler, a computer program which produces computer oriented object code from a program written in a problem or procedure oriented language. See compile and processor (1).

computer, a device capable of accepting information, applying prescribed processes to the information, and supplying results.

computer, analog, a computer which represents variables by physical analogies.

computer, asynchronous, a computer in which the performance of each operation starts as a result of a signal either that the previous operation has been completed, or that the parts of the computer required for the next operation are now available; contrasted with computer, synchronous.

computer, digital, a computer which processes information represented by combinations of discrete or discontinuous data; it performs sequences of arithmetic and logical operations.

computer fixed program, a computer in which the sequence of operations is placed either in a read-only store or is wired into the circuitry.

computer, general purpose, a computer which is designed to solve a wide variety of problems as directed by its program; most such computers are programmed by instructions stored in the memory or in other storage such as a card sequence.

computer, special purpose, a computer designed to solve a specific class of problems, frequently a subsystem of a larger complex such as the process control computer in a chemical processing plant.

computer, synchronous, a computer in which all operations and events are performed in accordance with a schedule timed by a clock.

computer, wired program, a computer in which the instruction sequence to be performed by the computer is specified by connecting wires plugged into a connection panel or control panel; a wired program computer may be general purpose with a flexibly programmed control panel, special purpose (also with a variable program), or a fixed program computer.

concept-intersect, a synonym for coordinate indexing.

console, (1) a portion of a computer at which the operator stations himself and which permits control of internal and external operations; (2) a remote device which permits entry of data into a computer and receipt of data from the computer; the data transfer may include instructions to the computer making possible remote programming.

control, numerical, an application of digital computers to the control of machines.

control, process. an application of both digital and analog computers to the management of processes of administration or manufacture; analog computers are frequently applied to the control of continuous processes such as chemical processing.

control, supervisory, direction of a digital computer by a program which oversees the operations of the computer, the transfer of data among the various items of peripheral equipment and the memory or main storage, directs the operation of programs, and maintains records of utilization.

correction, automatic, a characteristic designed into computer systems using special redundant codes which permit both error detection and error identification; automatic error correction systems do not eliminate all errors, but reduce the likelihood of errors; if errors become more frequent than the system is designed to handle, errors may escape detection.

counter, a device, register, or location in storage for number representations such that the number is increased or decreased in accordance with prescribed conditions.

counter, control, a device which records the storage location of the instruction which is to be operated next.

counter, location, (also called "instruction counter") a device which records the storage location of the instruction which is currently being operated.

cycle, storage, the complete sequence of events connected with transferring information into or out of a storage device; standard magnetic core storage requires that, when information is sensed in the memory, it be written back into the memory unless the programmer wishes the memory left with incorrect content.

data, a general term for inputs to and outputs from a program or for reference facts used either to guide the program design or to test the program.

debug, to locate or correct errors either in a program or in a computer.

deck, a collection of cards, usually associated cards belonging to a single set, which have been punched for a specific purpose.

density, character, the number of characters that can be stored per unit length of tape or drum or disk surface, measured in bits per inch along a tape channel or characters per inch.

digit, a sign or symbol used to represent a number.

digit, binary, one of the two binary digits of the set (0, 1); binary digits may be strung together to represent binary numbers or they may be used in Boolean algebra to represent either (yes, no) or to represent the signs (+, -).

digit, check, one or more redundant digits carried along with a character, computer word, or series of characters or words used in self-checking or self-correcting error reduction systems.

digit, octal, one of the eight octal digits of the set (0, 1, 2, ... 7) used in a system of numerical notation employing 8 as its radix.

digit, decimal, one of the ten decimal digits of the set (0, 1, 2, ... 9) used in a system of numerical notation employing 10 as its radix.

digit, hexadecimal, one of the sixteen hexadecimal digits of the set (0, 1, 2, ... 9, a, b, c, d, e, f) used in a system of numerical notation using 16 as its radix.

disk, magnetic, a storage device using a rotating plane surface coated with magnetic material; information is stored on the surface as recorded magnetic dipoles; these dipoles are written and sensed by a magnetic head, usually mobile, rarely in a rigid array; the sequence of dipoles under a head position is called a track or channel.

drum, magnetic, a storage device using a rotating cylinder coated with magnetic materials; information is stored on the surface as recorded magnetic dipoles; these dipoles are written and sensed by a magnetic head, usually one of a large number mounted in a fixed array; the sequence of dipoles under a head position is called a track or channel; drums usually have more rapid access than disks with mobile heads; character density on drums can be constant (whereas disk densities vary from the inside to the outside tracks); drums are bulkier than disk units.

dump, storage, (also called memory dump) a listing of the contents of a storage device or of selected portions; if the list is printed, it is referred to as a storage or memory printout.

EAM, Electrical Accounting Machinery.

EBCDIC, Extended Binary Coded Decimal Interchange Code.

edit, , a collective term for data processing functions required by a particular program or system which are incidental though necessary to the main purpose of the program; these functions typically occur on input of data (selection and rearrangement) or on output (rearrangement of formats, suppression of zeros, rounding and truncating of numerals, adding row and column titles, headings, page numbers, and so forth).

EDP, Electronic Data Processing.

element, data, (also called an item) a specific item of information in a set of data describing an object.

EOF, End Of File; termination of point of completion of a quantity of data marked by an EOF mark.

equipment, off-line, peripheral equipment or devices not directly connected to the central processor of a computer.

equipment, peripheral, the auxilliary machines and equipment which may be placed under control of the central processor of a computer; examples are card readers and punches, magnetic tape handlers, magnetic disks and drums, printers, and communications equipment.

equipment, tabulating, the machines and equipment using punched cards; synonym for electronic accounting machinery.

error, rounding, the error resulting from applying the rounding rule for deleting less significant digits; for example, if n is the number of digits to be retained, add 5 to the n+1st digit and truncate; 2.756 rounds to 2.76 with an error of +.004 and 2.751 rounds to 2.75 with an error of -.001.

error, truncation, the error resulting from simply dropping trailing digits.

field, an assigned area in a record to be marked with a data element.

field, card, a set of card columns designated to be punched with a data element.

field, fixed, a field of constant length on each card or in a continuous magnetic record.

field, variable, a field of variable length either on a punched card or in a continuous magnetic record; the boundaries of the field may be indicated either by a flag or by information stored in another location.

flag, (1) a bit of information attached to a character or word indicating the boundary of a field; (2) an indicator used in a program to signal a processing condition or requirement to a different portion of a program; (3) an indicator to distinguish the members of sets which are intermixed.

format, the predetermined arrangement of characters, fields, tables, rows, columns, headings, page numerals, etc., on a single print sheet or in a single file or record.

FORTRAN, a programming language designed for solving problems including a substantial proportion of mathematics.

frame, main (also called Central Processing Unit or CPU), (1) the portion of the computer which includes the main storage or memory, the arithmetic unit, and the special registers; (2) all that portion of a computer exclusive of the input, output, peripheral equipments and some storage units.

gangpunch, to punch identical or constant information into all of a group of punch cards.

gap, inter-record, an interval of space or time, deliberately left between portions of data recorded on tape; the gaps are necessary to prevent loss of data while starting or stopping the tape.

hang-up, (1) a nonprogrammed stop in a routine; (2) the failure of a program to branch out of a program loop.

hardware, the physical equipment or devices forming a computer and peripheral equipment associated with it; contrasted with software.

hierarchy, a specified rank or order of things, thus a series of items classified by rank or order.

Hollerith, (1) a system of encoding peculiar to 80-column cards named after Hermann Hollerith, an employee of the U. S. Census in 1890; (2) in the form "6-bit Hollerith", an improper designation of one of a number of alphanumeric codes, e. g., the code used on 90-column cards.

housekeeping, administrative functions relating to the maintenance of data in peripheral storage and to the maintenance of records of such data.

IAL, International Algebraic Language, the forerunner of ALGOL.

image, the duplicate of a data array transferred to a different recording medium without editing.

image, card, a representation in storage of the data punched in a card.

index, a symbol or number used to identify a particular quantity in an array of similar quantities.

initialize, to set various counters, switches, and other registers to predetermined values required for operation of a particular program or subroutine.

instruction, (1) a set of characters which define a computer operation together with locations of data required to perform the designated operation; (2) the operation itself.

interpret, (1) to print information punched into a card on that card in readable alphanumeric form; (2) to translate non-machine language instructions into machine language instructions.

interrupt, to halt an ongoing routine by an external signal and transfer operation temporarily to another routine or program such that it is possible to return to the original point when the interim process has been completed.

I/O, an abbreviation for input/output.

iterative, descriptive of a procedure or process which repeats a series of operations until some defined condition is satisfied.

keypunch, (1) a special device to record information in cards by punching holes to represent a character set; (2) to operate such a device.

key-verify, to use a special device similar to a keypunch, called a verifier, to check the correctness of data entered into punched cards; the verifier automatically recognizes a discrepancy between the data keyed into it by the operator and the data it reads in the previously keypunched card; alternatively referred to simply as verify.

label, a set of symbols used to identify or describe a record, message, or file.

language, a system for representing and communicating information concerning data, relationships, and processes between people or between people and computers; the language consists of a vocabulary and rules for combining various elements of the vocabulary into meaningful statements.

language, machine oriented, a programming language in which the vocabulary is determined by the address structure and the operational code of the computer.

language, object, a language which is the output of an automatic coding program or compiler; usually the object language is machine language but it may also be the language accepted by the assembler.

language, problem oriented, (1) a language designed for convenience in writing programs and with a vocabulary and syntax closely related to the basic problem structure; (2) a machine independent language in which it is necessary only to formulate the problem, while the solution is implicit in the processing programs.

language, procedure oriented, a language designed to make it convenient for the programmer to designate the problem solving process with a substantial amount of machine independence; FORTRAN and COBOL are procedure oriented; the machine independence of FORTRAN lies in the generality of its mathematic facilities; the machine independence of COBOL is facilitated by separating the procedure specifications from those specifications which describe the hardware environment.

language, source, the language in which a program is prepared for processing by machine into object language.

library, subroutine, (also called a routine library) a collection of proven subroutines maintained in machine language on magnetic record for reference by an assembler or compiler or by an on-line system.

location, a storage position in the main storage of the central processor which is designated by an address and which can contain data or instructions or be treated as a special register for control or programming purposes.

log, a record of a machine run indicating the source of the request, time of run, record of machine configuration used, settings of special switches and registers, copy of key-in, identification of magnetic tapes or disk packs and of card decks used, special actions taken, and results including expired time.

loop, program, a sequence of instructions terminating in a conditional branch instruction which causes the sequence to be repeated until the predefined condition is reached.

macro, (also called macro-instruction) an instruction in a machine oriented language, e. g., in assembly language, which designates a series of machine language instructions.

machinery, electrical accounting, the set of conventional punchcard equipment including sorters, collators, and tabulators; EAM.

maintenance, file, the periodic modification of records, especially in magnetic form, to incorporate changes, deletions, and additions, and to keep the reference apparatus current.

masking, a process for extracting specific bits of information out of a computer word or character.

matrix, (1) in mathematics, an array of quantities in prescribed form; (2) an array of circuit elements in a computer or peripheral equipment.

merge, to combine items from two or more sequenced files into a single sequenced file without changing the order.

mnemonic, pertaining to assisting or intending to assist the human memory; descriptive of abbreviations or encoding which is easy to remember such as mpy for multiply or acc for accumulator.

multiplex, describing the mode of transferring separate trains of data simultaneously over a single channel by interleaving the data; used to transfer data among numerous peripheral and storage devices whose input/output data rates are a fraction of the permissible data rate of the communication channel.

multiprocessor, an electronic data processing system provided with multiple central processing units simultaneously sharing main storage and peripheral equipment.

multiprogramming, a technique for utilizing a single central processing unit to process simultaneously a number of independent, interleaved programs.

number, binary, a numeral employing the binary digits $N_2 = (0, 1)$; the binary place system is illustrated below; if the place P first left of the binary point is numbered zero, the places left of zero are counted positive and those right are counted negative, the value of the number is given by

$$n = \sum (N_P (2)^P).$$

Decimal Numeral	Binary Numeral
0.125	0.001
.25	.01
.5	.1
0.0	0.0
1.	1.
2.	10.
3.	11.
4.	100.

number, hexadecimal, a numeral employing the hexadecimal digits $N_{16} = (0, 1, 2, \ldots 9, a, b, c, d, e, f)$ in the hexadecimal place system where the place P first left of the hexadecimal point is numered zero, the places left of the zero point are counted positive and those to the right are counted negative, and the value of the number is given by

$$n = \sum (N_P (16)^P).$$

Decimal Numeral	Hexadecimal Numeral	Binary Numeral
1	1	1
9	9	1001
10	a	1010
11	b	1011
12	c	1100
13	d	1101
14	e	1110

Decimal Numeral	Hexadecimal Numeral	Binary Numeral
15	f	1111
16	10	1 0000
17	11	1 0001
31	1f	1 1111
32	20	10 0000

The hexadecimal system is used by programmers as a shorthand notation for binary numerals grouped into periods of four.

number, octal, a numeral employing the octal digits $N_8 = (0, 1, 2, \ldots 7)$ in the octal place system where the place P first left of the octal point is numbered zero, the places to the left of the zero place are counted positive and those to the right are counted negative, and the value of the number is given by

$$n = \sum (N_P (8)^P).$$

Decimal Numeral	Octal Numeral	Binary Numeral
1	1	1
2	2	10
3	3	11
4	4	100
5	5	101
6	6	110
7	7	111
8	10	1 000
9	11	1 001
10	12	1 010
15	17	1 111
16	20	10 000
31	37	11 111
32	40	100 000

The octal system is used by programmers as a shorthand notation for binary numbers grouped into periods of three.

off-line, descriptive of the state of peripheral equipment of a data processing system in which the equipment is not under direct control of the central processing unit.

on-line, descriptive of the state of peripheral equipment of a data processing system in which the equipment is under direct control of the central processing unit.

operand, a quantity upon which a computer instruction operates.

operations, an action of the central processing unit or of peripheral equipment control units specified by a computer instruction or a language expression.

operation, real time, the use of a computer through on-line peripheral equipment such that the computer programs and functions keep up with or ahead of the input and output requirements imposed from outside the system.

operations research, a collection of analytical methods and procedures used by systems analysts to solve certain classes of operational problem such as optimal allocation of resources, prediction of performance, and so forth; also the field of endeavor dealing with such operational problems.

overflow, a condition which results if the output of an operation exceeds the capacity of the register into which it is to be written.

overlay, (1) a technique for placing different routines or subroutines in the same area of main storage during processing to conserve processing space; (2) a technique for assigning different meanings to the same data array during different stages of processing.

pack, a technique for conserving storage area by storing a number of items into a single character or computer word.

panel, control, a removable connection board used for programming wired program computers and peripheral equipment and for programming EAM.

parameter, (1) a quantity in a subroutine whose value specifies or partly specifies the process to be performed; (2) a quantity used in a processing program such as a compiler to specify the machine configuration or to control the compilation; (3) a definable characteristic of an item, device, or system.

pass, a complete cycle of reading, processing, and writing with EAM or a computer.

patch, (1) a section of coding introduced into a program to alter the process without recompiling or to correct a mistake; (2) to correct a programming error without recoding the program.

peek-a-boo, an information retrieval system which uses peek-a-boo cards, into which small holes have been drilled at the intersections of coordinates (column and row designations) to represent document numbers; each card represents a descriptor of information (usually bearing the appropriate term printed at the top); large holes are punched to identify the number of the document to which the descriptor applies; if a set of descriptor cards is selected, the holes through which light is visible identify the documents to which the descriptors apply.

position, punch, the row position in a specific column of a punch card; the rows of an 80-column card are designated Y, X, 0, 1, 2, . . . 9; the rows of a 90-column card are designated 0, 1, 3, 5, 7, and 9.

precision, double, the allocation of twice the normal number of storage registers to each number which the computer normally uses in arithmetic operations.

procedure, a precise step-by-step method for solving a problem or accomplishing a process.

process, iterative, a process for calculating a desired result by means of a cycle of operations which is repeated until some criterion is satisfied.

processing, batch, a technique for using a computer in which data processing tasks are grouped so that programs operate on as many similar tasks as possible before being replaced in the central processor by other programs; contrasted with multiprogramming and time sharing.

processor, (1) a generic term for programs including those which produce object language from subject language programs (especially used of COBOL); (2) a shorter term for central processing unit.

program, (1) a complete set of instructions in a programming language which will solve a problem; (2) to design and encode a program.

program, object, the program in object language produced by a compiler or processor.

program, source, the program in source language upon which a compiler or processor operates to produce an object program.

program, supervisory, a program (also called an executive) which remains in main storage and controls peripheral equipment and controls the operation of programs whether in a batch processing, multiprogramming, or time sharing system.

punch, card, a machine which punches holes in punch cards; an item of peripheral equipment used as an output device especially to create decks of cards to record an object program or a data file.

punch, gang, to punch identical information into certain fields of a deck of punched cards.

punch, spot, a hand operated device for punching individual holes in punch cards.

punch, summary, a card punch operating in conjunction with another machine such as a tabulator to record data for future use.

punch, X-, a punch in the X or 11 row of an 80-column card; with EAM systems the X-punch is often used to control, select, or indicate a negative number; also called 11-punch.

punch, Y-, a punch in the top, X, or 12 row of an 80-column card; with EAM systems the Y-punch is used for additional control and to indicate a positive number; also called 12-punch.

radix, the base of a number system; see number, binary, decimal, octal, and hexadecimal.

range, the set of values which a number or variable may take or the difference between the highest and lowest values of a number.

rate, bit, the measure of rapidity at which binary digits or bits can pass along a channel or into and out of peripheral equipment or storage units.

record, (1) a group of related items or fields treated as a unit; (2) to put data into a storage device.

record, fixed length, a record containing a fixed number of characters.

record, trailer, a record which follows a group of records and contains data pertinent to them.

register, a hardware device used to store a fixed number of bits, bytes, or characters; usually used to designate storage devices for special purposes, such as the accumulator which stores the output of the adder, an index-register, a program counter, and so forth.

register, index, a register which contains a number which may be used to modify addresses; usually the index register is incremented or decremented at the end of a short loop and maintains a count to control an algorithm or to control the use of elements of data in an array.

register, instruction, a register which contains the current instruction on which the central processing unit is working.

register, storage, (also referred to as a memory register) a register in main storage as opposed to a separate special register; a register in the main storage which can be addressed by a program instruction.

registration, the accuracy of the positioning of holes in a punched card.

repertory, instruction, the set of instructions recognized by a data processing system or processor.

routine, a set of instructions in sequence to perform a desired operation or set of operations.

routine, closed, a routine which is not inserted as a block of instructions in a program but is entered by a linkage from the main program.

routine, executive, a routine which controls loading and relocation of programs and data and which may perform linkages under the guidance of the operator; it remains loaded in main storage during processing; sometimes called supervisory program.

routine, open, a routine which can be inserted directly into a larger routine without a linkage or calling sequence.

row, binary, a method of representing binary numbers on a punched card in which successive bits are represented by the presence or absence of punches in sequence in rows rather than in columns as in column binary.

run, the performance of one program on a computer.

scale, (1) a range of values frequently dictated by the computer word length; (2) to make modifications to values of variables and methods of handling them so as to avoid exceeding capacity of registers.

search, to read through records in a file to locate records with given characteristics or parameter values.

search, binary, a search in which the series of items is divided into two parts, one of which is rejected, and the process repeated until the desired parameter value is found.

sequence, (1) to place symbols, records, cards, and so forth, into order in accordance with a counter; (2) to mark the sequence of cards; (3) an arbitrary order of symbols, instructions, and so forth.

sequence, calling, the instruction format used to link a closed subroutine to the main program or to enter the subroutine from the main program.

shop, closed, an arrangement for the operation of a computer facility where programming service to users does not permit programmers to have access to the computer console directly; programmers must communicate with the operator who has full charge of the computer and carries out the instructions of the programmers as specified in the run request.

shop, open, an arrangement for the operation of a computer facility where programmers may actually run the computer or at least assist at the machine run and instruct the operator as to the kinds of action he should take when a hang-up is encountered or the supervisory program stops the run and prints out diagnostic messages.

simulator, (1) (also referred to as an emulator) a computer program which makes a computer operate programs coded for a different computer; (2) a computer program or program system which imitates the operation of the object program which is being studied or controlled; (3) a program which imitates the mathematical representation of a phusical model.

software, (1) the set of programs including supervisory programs, processors, utility programs, and so forth, written for and supplied with a computer; (2) the complete set of processes involved in utilizing a computer system, including programs and procedures for human beings such as forms and documents.

sort, to arrange items of information and their associated cards, records, and so forth, into groups and sequences in accordance with rules and parameters.

sort, block, a sort beginning with the most significant characters in a number or other key whose purpose is to break the data into records of manageable size for further processing.

sort, four-tape, a technique for sorting rapidly two unsorted intput tapes into incomplete sequences on two output tapes which again are sorted into successively longer sequences after each successive pass until the data and records are all properly sequenced on a single output tape.

sort, merge, to produce a single sequence of records ordered according to some rule, without changing the format or number of records.

sorter, card, a machine which sorts cards into sequence in accordance with the values of specific characters.

source data automation, a collective term for various techniques for using equipment which automatically converts input data into machine readable form.

storage, the device in which data and programs can be written and from which they can be read by the central processing unit.

storage, auxiliary, a device such as a magnetic drum, disk, or tape, which can hold information that will not fit in the main storage.

storage, buffer, a device used for temporary storage for a variety of reasons, including permitting access by multiple consoles, communication with multiple peripheral devices with varying data rates, communicating with other computers, especially over long distance communication links, and facilitating editing.

storage, core, a storage device in which binary data is represented by the magnetization of magnetizable rings; a peculiarity of magnetic cores is that when they are read, the information is destroyed and must be rewritten; some computers make use of the difference between the access or read cycle and the complete read-write cycle in their timing schemes.

storage dynamic, a characteristic of multiprogramming and real time and time sharing systems in which the location of data is controlled by the executive routine to obtain the greatest efficiency in the use of the storage and to minimize time lost due to transfers of data into and out of memory while a program is waiting; actual location of both program and data in the main store are determined at the time the program, data are loaded from periperal or auxiliary storage, and special hardware facilities are provided to convert automatically the address references in the program to the storage locations.

storage, magnetic disk, a storage device or system based on magnetic disks which rotate at a continuous rate and are written on and read from by either movable magnetic heads or an array of stationary heads; the access time to data on a disk is the time necessary to reach the data and depends on the rotation rate of the disk, the time necessary to move the arm and head over the track (instantaneous for stationary arms) and the time to move the arm to the appropriate disk (instantaneous if there is an arm for each disk); if the disks are dismountable (disk packs), the time needed to retrieve the disk from the library and mount it on the disk storage unit must also be considered.

storage, magnetic tape, a storage device based on magnetic tape transports which move in a start-stop fashion under control of a tape controller which in turn is under the control of the central processing unit; magnetic tape is usually read in data units termed records which are the smallest sections of tape which can be read under unit control by a single command; the access time to data must include the read-write rate which is the rate at which data can be transferred from tape to main storage, the record gaps which contain no data but which permit start-stop operation, and the distance the tape must move from its starting position to where the data can be found; magnetic tapes can usually be searched both forward and backward; tape records and files are usually identified by labels rather than addresses, and the labels must be read into main storage to be examined and either accepted as the sought data or rejected.

storage, program, a portion of the main storage of the central processor which is reserved for programs and which must be protected from inadvertent access; if data are written over a section of program, the program will probably malfunction; protection schemes may either rely on programming techniques or may in some computers (especially in those designed for time-sharing operation) be aided by special protection facilities and commands built into the hardware and into the instruction repertory.

storage, thin film, special high speed storage facilities based on thin film technology and used in some third generation computers as read-only memory providing fixed program facilities in a stored program computer for certain operations.

storage, working, a portion of the main storage of the central processor which is used for data; distinguished from program storage; working storage may be dynamically assigned in multiprogramming and time shared operations and protected from being written into by any but a specifically assigned program.

subroutine, see explanation of routine.

system, operating, a collection of service routines designed to work together to facilitate the use of a computer system; the operating system usually includes an executive routine, programs which facilitate testing and debugging, and facilities for performing various standard operations; sometimes also called a utility system.

tape, magnetic, a ribbon of flexible material, coated with a magnetizable material and wound on spools or contained in a cartridge, on which information can be recorded in binary form as magnetic dipoles; information stored on magnetic tape may deteriorate with time, especially as a result of outside magnetic influences and must be protected against them; the apparatus which is used to deliberately erase the tape is called a degausser.

tape, master, a magnetic tape containing programs; a system master tape contains the operating system for the computer, including the executive routine.

tape, paper, a strip of paper capable of storing information usually in the form of punched holes; in contrast with magnetic tape, such paper tape can be used only once; paper tape may be used for short master programs, for input of data (especially data punched by teletype), and sometimes for output of data.

time sharing, the use of a device or especially of a data processing system for more than one purpose simultaneously by interspersing the operations supporting each user in a controlled and accountable fashion; especially the sharing of a large data processing system by a number of distant users each having access to the system through a console and communication links.

time, down, the period during which a computer or item of peripheral equipment or of EAM is not available because of failure or maintenance operations.

time, up, the period during which equipment is available for productive work.

total, control, a sum of numbers in specific fields of a series of records used to assure that the processing system is working properly and is not dropping or altering data; the number is recomputed every time the records are read and is compared with the prerecorded control total.

total, hash, essentially the same as control total; the term hash total refers especially to the procedure of ignoring the significance of the data contained in the field and of treating all data and instruction codes as if they were numeric information.

trap, a special technique for halting a program under specified conditions to permit special actions; used in debugging programs; a trap normally results in a signal to the operator to take special actions.

update, to modify the contents of storage to reflect current conditions as a result of processing.

USASCII, United States of America Standard Code for Information Interchange.

verify, to check a transcribing operation, especially to check the correctness of data punched into cards using a key verifier.

word, an ordered set of characters occupying a single storage location, usually of prescribed length, measured in bits and bytes.

word mark, in variable word length machines, a flag indicating the beginning or end of a word.

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Manufacturer's Literature

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VISUAL AIDS

The following list of films derives from the efforts of Mr. George Heller of the International Business Machines Corporation and Mr. Alec Bumstead of the System Development Corporation for the Association for Computing Machinery and the Data Processing Management Association.

The course for computer operators consists of a mixture of classroom and laboratory periods; but some of the units, not lending themselves to laboratory work, call only for classroom activities. Films can provide the instructor with a means for introducing some variety into the periods and with a substitute for direct exposure to some of the equipment and operational situations which can not be offered the trainees. No attempt is made in this course guide to dictate precisely when films should be employed. The instructor will have to judge for himself when his trainees will be most receptive to the material and the form of presentation.

This list is divided into two sections. The first section contains films which are available free of charge. Many of them have a strong promotional flavor. The second section lists the price of the films for which a charge is made.

Free Films

Adventure in Space. 14 1/2 min., 16 mm., sd., color. International Business Machines Corporation. (Contact your local representative.)
Summary: This is the story of the history-making flight of Gemini 8 shown from lift-off to splashdown, and includes man's first spacecraft docking as photographed by the astronauts. Much of the behind-the-scenes action of the thousands of people who provide the ground-based control of manned space flights is also shown, including candid commentary by two computer specialists. Mission photography was provided through the courtesy of NASA.

America's Rising New Giant. 22 min., 16 mm., sd., color. DeVry Technical Institute, 4141 Belmont Avenue, Chicago, Ill. 60641. 1951.
Summary: This color film demonstrates how and why electronics has become one of America's most promising fields of opportunity; interest-gripping sequences illustrate the use of electronics in industry and other phases of everyday life. It also includes late (1951) developments such as computers and transistors. A film with appeal to vocational guidance groups, as well as to any audience interested in learning about the electronic age in which we live.

The Automation of B. J. Blurch, Inc. 16 min., 16 mm., sd., color. Data Processing Management Association, International Headquarters, 524 Busse Highway, Park Ridge, Ill. 60068. 1959.
Summary: This film was produced in connection with the DPMA 1959 National Conference in St. Louis. It depicts some of the problems of management planning for the installation of data processing equipment. It is realistic in text, but also animated with humor. The film points out that as we

move into high speed processing and stored programming, planning may be done by executive menagement, but actual preparation will be done by data processing personnel.

Automation in the Air Traffic Control. 11 min., 16 mm., sd., b&w. UNIVAC Division of the Sperry-Rand Corporation, Advertising and Sales Promotion Department, 1290 Avenue of Americas, New York, N. Y. 10019. 1960.
Summary: Shows the detailed data processing procedures involved in a typical flight from Boston to Washington, D. C. Follows the flight from the filing of the flight plan to arrival at the destination. Examples illustrate how the UNIVAC File Computer handles each phase of the flight, compensating for and correcting such variables as late take-off and conflicting flight plans.

The Cards That Count. 15 min., 16 mm., sd., color. International Business Machines Corporation. (Contact your local representative.)
Summary: A detailed account of the meticulous quality control that assures the reliability of the IBM card. Punched cards have been used as a prime carrier of information in data processing systems for more than half a century.

Census '60. 13 min., 16 mm., sd., b&w. Data Processing Management Association, International Headquarters, 524 Busse Highway, Park Ridge, Ill. 60068. 1960.
Summary: An explanation of why and how U. S. Census data is collected, compiled and evaluated using FOSDIC (Film Optical Sensing Device for Input to Computers) and the UNIVAC 1105 Scientific Computer.

The Computer Comes to Marketing. 29 min., 16 mm., sd., b&w. Fortune Films, Time and Life Building, Rockefeller Center, New York, N. Y. 10020. 1960.
Summary: This film uses the device of a "committee" of marketing executives who have been delegated to investigate potential benefits to their own company if it should get a computer. They report to each other on what they find out in the course of a broad study of computer use by other companies. The cases they discuss are based on actual situations researched by Fortune Magazine. Thus the film presents an insight into many successful computer applications in the whole range of marketing, from production control as it is related to distribution, through inventory control, improved customer service and sales forecasting.

Computer Programming (XF-8). 26 min., 16 mm., sd., b&w. System Development Corporation, 2500 Colorado Avenue, Santa Monica, Calif. 90404.
Summary: This film on basic programming produced by SDC and filmed by UPA. A good film to show to logically-minded prospective programmers or those interested in knowing what a programmer does.

Digital Computer Techniques - Introduction - MN-8969A. 20 min., 16 mm., sd., color. United States Navy. (Contact the Naval District in which you are located, see page 174).
Summary: Itroduction to digital computers. Historical origins of calculating devices. Differences between analog and digital computers.

Digital Computer Techniques - Computer Logic - Part I - Binary Numbers - MN-8969B. 20 min. 16 mm., sd., color. United States Navy. (Contact

the Naval District in which you are located, see page 174).
Summary: Explains binary number system and defines several meanings of logic applied to computers. Differences between decimal and binary number systems outlined.

Digital Computer Techniques - Computer Logic - Part II - Logic Symbology - MN-8969C. 15 min., 16 mm., sd., color. United States Navy. (Contact the Naval District in which you are located, see page 174 below.) 1962.
Summary: Basic U. S. military standard symbols for logic elements of computers as introduction to digital computer logic symbology (AND, OR, OR EXCLUSIVE, NOR, DELAY, INVERTER, FLIP-FLOP).

Digital Computer Techniques - Computer Units - MN-8969D. 24 min., 16 mm., sd., color. United States Navy. (Contact the Naval District in which you are located, see page below). 1962.
Summary: Units of a digital computer; input unit, output unit, arithmetic unit, and control unit.

EDP for Your Payroll. 14 min., 16 mm., sd., color. Bank of America, Training and Development Section, One South Van Ness, San Francisco, Calif. 94120. 1962.
Summary: This film introduces a time-and-money-saving miracle to those unfamiliar with Electronic Data Processing and explains both the payroll service plan and its benefits to large and small business. The film shows how to speed up the paying out and recording of salary checks and how to provide controlling indicators.

The Electronic Retina Computing Reader. 16 mm., sd., color. Recognition Equipment, Incorporated, 815 Connecticut Avenue, N. W., Washington, D. C. 20006. 1966.
Summary: This film presents optical character recognition equipment as an answer to the growing costs and problems of computer input. A basic understanding of the OCR technology is conveyed to the viewer. Examples of OCR systems which are proving this new technology are presented to show that OCR has come of age.

The Electronic Shelf. 20 min., 16 mm., sd., color. UNIVAC Division of Sperry-Rand Corporation, Advertising and Sales Promotion Department, 1290 Avenue of Americas, New York, N. Y. 10019. 1963.
Summary: Dr. Carl Hammer describes the subject of information retrieval and how UNIVAC computers with their array of input/output and mass storage devices of varying capacity and speed solve the increasingly complex problems encountered in today's information retieval techniques.

Electronics in Automation. 22 min. 16 mm., sd., color. DeVry Technical Institute, 4141 Belmont Avenue, Chicago, Ill. 60641. 1956.
Summary: A demonstration of the many opportunities in the field of automation. The much-discussed "push-button plant" of the future is graphically illustrated, section by section with full color sequences showing many applications of electronic controls to production processes. Recently developed computers (as of 1956) and other electronic devices illustrate the part automation is expected to play in modern offices. Suited to vocational guidance work, this film demonstrates the progress in American industry as a result of advances in electronic data processing.

The IBM 1404 Printer. 8 min., 16 mm., sd., b&w. International Business Machines Corporation. (Contact your local representative.) 1962.
Summary: Illustrates the functional principles of the 1404 Chain Printer for the IBM 1401 Data Processing System. Included are suggested application areas for "cut" card forms which the 1404 printer is able to print on because of its bill feed capacity. Best suited for audiences with some knowledge of this subject.

The IBM 1428 Alphameric Optical Reader. 11 min., 16 mm., sd., color. International Business Machines Corporation. (Contact your local representative.) 1962.
Summary: Describes the IBM principle of optical character reading and shows dramatically the many outstanding features of the IBM 1428. The film details both its functions and use in a clear, easy-to-understand fashion.

The Information Machine. 16 mm., sd., color. International Business Machines Corporation. (Contact your local representative.)
Summary: A sophisticated, sometimes amusing account of the development of the electronic computer beginning with primitive man and ending with the advent of machine simulation. Colorful and imaginative, this makes an effective communications device for explaining the nature of data processing. It was selected as an U. S. entry for the Edinburgh Film Festival.

Information Retrieval. 18 min., 16 mm., sd., color. International Business Machines Corporation. (Contact your local representative.)
Summary: The movie describes how a theoretical, but typical large company solves its communications problems by adopting modern information retrieval procedures, using conventional IBM data processing systems. Deals with KWIC indexing, research project retrieval, SDI, document retrieval, skill indexing.

An Introduction to Digital Computers. 35 min., 16 mm., sd., color. UNIVAC Division of the Sperry-Rand Corporation, Advertising and Sales Promotion Department, 1290 Avenue of Americas, New York, N. Y. 10019. 1959.
Summary: "What is a computer?" and "How does it work?" are questions answered with animated sequences explaining the five basic functions of a computer - input, control, arithmetic, memory, and output.

Management of a Time-Shared System (XF-24). 14 min., 16 mm., sd., b&w. System Development Corporation, 2500 Colorado Avenue, Santa Monica, Calif. 90404.
Summary: This film describes the SDC/ARPA general purpose time-sharing system operating on the AN/GSQ-32 computer, with emphasis on the novel techniques used to allocate space and time to the more than 300 authorized users of the system. It is intended for a semi-technical audience of programmers, system designers, and those having some acquaintance with time-sharing. This was a prototype, non-commercial installation.

Mark of Man. 10 min., 16 mm., sd., color. Stromberg Carlson Corporation, Post Office Box 2449, San Diego Calif. 92112.
Summary: A study of the ways man has used data processing from ancient times to the present.

Memory Devices. 30 min., 16 mm., sd., b&w. Western Electric. (Contact your local telephone company.)

Summary: Basic concepts of information storage devices and examples of mechanical, electro-mechanical, magnetic, electrostatic, and photographic memories are described and storage of binary information is explained.

One Step Behind - One Step Ahead (XF-22). 30 min., 16 mm., sd., b&w. System Development Corporation, 2500 Colorado Avenue, Santa Monica, Calif. 90404.
Summary: The film tells the story of a criminal and his girlfriend who are apprehended after they have robbed a drug store of its receipts and some drugs. The criminal has a faily lengthy record; his girl does not. As the case proceeds, the film shows how the New York State Identification and Intelligence System will aid agencies of criminal justice. The film was written and directed by Richard Tuber and narrated by Jack Webb.

Principles of Electronic Data Processing. 16 min., 16 mm., sd., color. International Business Machines Corporation. (Contact your local representative.) 1960.
Summary: A definition of the basic principles of electronic data processing is the theme of this movie. It explains the provisions for input, storage, processing, and output of data at the speed of light, and in infinitesimal space. It touches on such things as punched cards, paper and magnetic tape, magnetic ink; magnetic core; drum, disk, and tape storage; central processing and console control.

Programming Languages (F-23). 5 min., 16 mm., sd., color. System Development Corporation, 2500 Colorado Avenue, Santa Monica, Calif. 90404.
Summary: Designed as an introduction to programming languages in computer-oriented systems, and touching upon the evolution of the SDC compiler language JOVIAL, this film is a pleasant aid for live briefing sessions on the "why" of all such languages. It can be useful as a point of departure for discussion or as a way of introducing non-programmers to programming.

The School Information Center. 12 min., 16 mm., sd., color. International Business Machines Corporation. (Contact your local representative.) 1963.
Summary: This film tells the story of how data processing equipment in a secondary school system can make more time available for student counseling. It is primarily a presentation of automated student record accounting, class scheduling, attendance recording, grade reporting, student guidance, permanent records, and class list applications.

Systems. 14 min., 16 mm., sd., b&w. International Business Machines Corporation. (Contact your local representative.)
Summary: Systems gives a simple explanation of how complex computers serve government, science, and industry. Problems which range from nationwide airline reservation systems to the ground control of manned space flight are described. The varied problem-solving role of computer systems is shown in an airline, in the papermaking industry, and in the NASA manned space flight center.

Time-Sharing on the Air (F-21). 30 min., 16 mm., sd., color. System Development Corporation, 2500 Colorado Avenue, Santa Monica, Calif. 90404.
Summary: The SDC-built, time-sharing system is described and discussed. It involves the development of a technology which enables may users to have simultaneous access to a very large computer by means of remote teletype units.

Then and Now. (VA U 3226). 12 min., 16 mm., sd., color. UNIVAC Division of the Sperry-Rand Corporation, Advertising and Sales Promotion Department, 1290 Avenue of Americas, New York, N. Y. 10019. 1961.
Summary: This film presents an account of the development of ENIAC, the first electronic computer, by J. Presper Eckert and Dr. John W. Mauchly. These two men, who were co-inventors of ENIAC, also discuss their continuing interest and activity in computer technology.

This Business of Numbers. (VA U 1201 Rev. 1). 20 min., 35mm., sd., color. UNIVAC Division of the Sperry-Rand Corporation, Advertising and Sales Promotion Department, 1290 Avenue of Americas, New York, N. Y., 10019. 1960.
Summary: From the caveman to the modern scientist, arithmetic is traced with amusing cartoons from its beginnings to modern data processing systems.

To Hare is Human. 8 min., 16 mm., sd., color. UNIVAC Division of the Sperry-Rand Corporation, Advertising and Sales Promotion Department, 1290 Avenue of Americas, New York, N. Y., 10019.
Summary: A humorous cartoon in which Bugs Bunny is kept busy countering schemes devised by the Wolf and his do-it-yourself computer kit.

Una and the UNIVAC. (VA U 2103). 16 min., 35 mm., sd., color. UNIVAC Division of the Sperry-Rand Corporation, Advertising and Sales Promotion Department, 1290 Avenue of Americas, New York, N. Y. 10019. 1960.
Summary: A basic interpretation of data processing from punched cards through the Babbage analytical engine. to today's computers. Shows how a computer handles a routine inventory problem, thereby freeing clerical workers, such as Una, for more creative and productive tasks. Cites broad uses of computers including weather forecasting, space research, engineering and medicine.

Union Carbide Nuclear Company. 12 min., 16 mm., sd., color. Union Carbide Nuclear Co., Industrial Relations Division, P. O. Box 1223, Paducah, Ky. 42001. 1960.
Summary: This film shows how the use of computers has increased the efficiency of the plant's stock and inventory control activities. The film is notable for its detailed analysis of how the present system was perfected and the ease with which it is operated. It traces the inventory story from the time an employee takes an item out of stock to when the Purchasing Agent arranges for a reorder.

The UNIVAC 1001 Card Controller. 11 min., 16 mm., sd., color. UNIVAC Division of the Sperry-Rand Corporation, Advertising and Sales Promotion Department, 1290 Avenue of Americas, New York, N. Y. 10019. 1965.
Summary: Introduces the UNIVAC 1001 Card Controller. Explains the functions, capabilities, and features of the machine. The first half of this film describes the Card Controller operating as an independent unit in its off-line mode, and the second half illustrates its operation on-line with the UNIVAC 1004 Processor. The film also portrays the 1004 peripherals. Unusual techniques make the presentation interesting to non-technical, as well as technically oriented viewers.

A Voice for Mercury. 14 1/2 min., 16 mm., sd., color. Western Electric Company. (Contact your local telephone company.) 1961.

Summary: The tense activity during flight is shown at several tracking stations as well as scenes of the building of the globe-circling communications and tracking network for the NASA Project Mercury. The blast-off and the lightning speed at which computers calculate orbital data with but seconds to produce the correct answers are part of this dramatic visit behind the scenes of the space age.

What Do You Want? (VA U 1736). 20 min., 16 mm., sd., color. UNIVAC Division of the Sperry-Rand Corporation, Advertising and Sales Promotion Department, 1290 Avenue of Americas, New York, N. Y., 10019. 1960.
Summary: Traces the development of electronic computers from ENIAC to UNIVAC III. Emphasizes how UNIVAC, backed by the resources of Sperry-Rand, pioneered as a leader in the development and production of computing systems. J. Presper Eckert, co-inventor of the first digital computer, discusses computers, exploring such areas as speed, storage, and applications.

Films for Which a Charge is Made

Automation. 84 min. (in three parts), 16 mm., sd., b&w. McGraw-Hill Book Co., Text-Film Department, 330 West 42d Street, New York, N. Y. 10036.
Summary: Edward R. Murrow explores the many problems connected with the revolutionary development of automation. Shows automation at work in dozens of industries, from aviation to baking. Views presented on automation's social and economic effects include those of Walter Reuther, Thomas Watson, Jr., and MIT Professor Gordon Brown, an authority on cybernetics. Write for the rental fee.

Automation, the Next Revolution. 28 min., 16 mm., sd., b&w. McGraw-Hill Book Co., Text-Film Department, 330 West 42d Street, New York, N. Y. 10036.
Summary: This film presents an analysis of the effect of automation on society. Its purpose is to help the audience to understand the challenge posed by the rapid growth of machine labor, to assess its potentialities, and to examine its dangers.
Price: $150.00

Base and Place. 30 min., 16 mm., sd., b&w. University of Colorado, Bureau of Audio-Visual Instruction, Stadium 348, Boulder, Colorado.
Summary: Presents the characteristics, history, and applications of binary number system. Emphasizes the basic principles of base and place in our system of numeration. Shows how numbers are represented in the binary system, its relationship to electronic digital computers, and how business applies the binary system. This is a kinescope, therefore, it will not have the sound and picture quality of a regular film.
Rental: $4.25.

Donald Duck in Mathmagic Land. 28 min., 16 mm., sd., color. University of Michigan, Audio-Visual Education Center, Ann Arbor, Mich.
Summary: Donald Duck, used to symbolize a layman's concept of mathematics as a boring and complicated subject, takes an exciting trip through the world of mathematics and learns the presence of mathematics in virtually every phase of our life - in music, architecture, fine arts, nature, mechanics and

invention, sports, and games.
Rental $10.00.

Electronic Computers and Applied Mathematics. 23 min., 16 mm., sd., b&w or color. John Colburn Associates, 1215 Washington Avenue, Wilamette, Ill. 60091. 1961.
Summary: Explains the basic principles and operations of electronic computers and the use of binary arithmetic so that number systems and the place value concept are more meaningful. Unusual uses of the computer stimulate interest in mathematics and science careers.
Rental: $10.00. Purchase price: color, $220.00; b&w, $110.00.

Electronic Computers Improve Management Control. 15 min., 16 mm., sd., color. University of California in Los Angeles, Extension Media Center, Media Distribution, 2223 Fulton Street, Berkeley, California. 94720.
Summary: Graphic animation techniques and live action are used in this film to present a hypothetical situation in which a customer cancels his ales order for furnityre because the manufacturer cannot make delivery on time. A subsequent investigation shows that the bottleneck was paper work. Actual production took only 16 days, but it took 28 days of paper work and delay before production could begin. This film demonstrates how electronic data processing machines could have processed the same order in 20 days less time. This time saving is attributed to four computer characteristics: high speed, greatest accuracy, a phenominal memory, the ability to communicate efficiently, and the ability to carry out a long series of operations without human intervention.

The Information Explosion. 21 min., 16 mm., sd., color. Association Instructional Materials, 37 Madison Avenue, New York, N. Y. 10017. 1964.
Summary: The purpose of this informative but non-technical film is to restore balance to our appraisal of the computer's true role in contemporary society, to show that the computer is the tool of man rather than the reverse. That man does the thinking which directs the computer is constantly emphasized. This rilm is excellent for junior and senior high school audiences as an introduction to the auromation process, with especial value to mathematics and science departments, as well as to vocational guidance counselors.
Rental: $5.00 per day. Purchase price: $194.00.

Programming in FORTRAN IV. 14 reels of 30 min. each, 16 mm., sd., University of California in Los Angeles, Extension Media Center, Media Distribution, 2223 Fulton Street, Berkeley, California 94720.
Summary: This is a complete course in computer programming on film. The course objective is to teach students how to program using FORTRAN. It was produced by the Department of Educational Television in cooperation with the Computer Center, University of California, Davis. Technical advisor was Ross Brown, M. A.
Rental basis: for each of the 14 lecture films: $10.00 for the first day,
$ 5.00 for additional consecutive days.
for all 14 films for 90 days: $900.00.

Sources of U. S. Navy Films

These films are available through the Naval District in which you are located. Simply address your information enquiry to the Commandant. The correct postal addresses are given below:

First Naval District
495 Sumner Street
Boston, Massachusetts 02110

Fourth Naval District
U. S. Naval Base
Philadelphia, Pennsylvania 19102

Sixth Naval District
U. S. Naval Station
Charleston, South Carolina 29408

Ninth Naval District
U. S. Naval Training Center
Great Lakes, Illinois 60088

Twelfth Naval District
Federal Office Building
San Francisco, California 94102

Potomac River Naval Command
U. S. Naval Station
Navy Yard Annex
Washington, D. C. 20390

Third Naval District
90 Church Street
New York, N. Y. 10017

Fifth Naval District
U. S. Naval Base
Norfolk, Virginia 23511

Eighth Naval District
U. S. Naval Station
New Orleans, Louisiana 70140

Eleventh Naval District
937 North Harbor Drive
San Diego, California 92130

Thirteenth Naval District
U. S. Naval Air Station
Seattle, Washington 98115

Appendix A

EQUIPMENT AND SUPPLIES FOR A 20 STUDENT CLASS

A. Equipment

4	Tables 6' x 30"
5	Tables 4' x 30"
21	Chairs
1	Storage Cabinet
1	Panel Cabinet
2	Wire Storage Drawers
5	Desks, Executive
5	Swivel Chairs
1	Desk, Secretarial
1	Posture Chair
8	Side Chairs
1	Opaque Projector
1	Punched Card Chalkboard
1	Interpreter Chalkboard
21	IBM Interpreter Control Panels
21	Wire Complements for Control Panel
11	UNIVAC 1004 Control Panels and Wires
1	Tape Recorder and Tapes
1	Spirit Duplicator
1	Overhead Projector
1	Projector Screen

B. Supplies

2500	Blank Manila Cards, Tabulating Machine
21	Flowcharting Templates
21	Flowcharting Worksheet Pads
15 pads	80-Column Card Layout Sheets
10 pads	Multiple Card Layout Sheets
10 pads	Keypunch Instruction Sheets
10 pads	Sorter Instruction Sheets
10 pads	Interpreter Control Panel Diagrams
250	Worksheet Pads
250	Pencils
20	Erasers
20	Colored Pencil Sets for Wiring Diagrams
20	Loose-leaf Binders
20 pkgs.	Loose-leaf Paper
1	Instructor's Roll Book
	Duplicator Paper
	Chalk

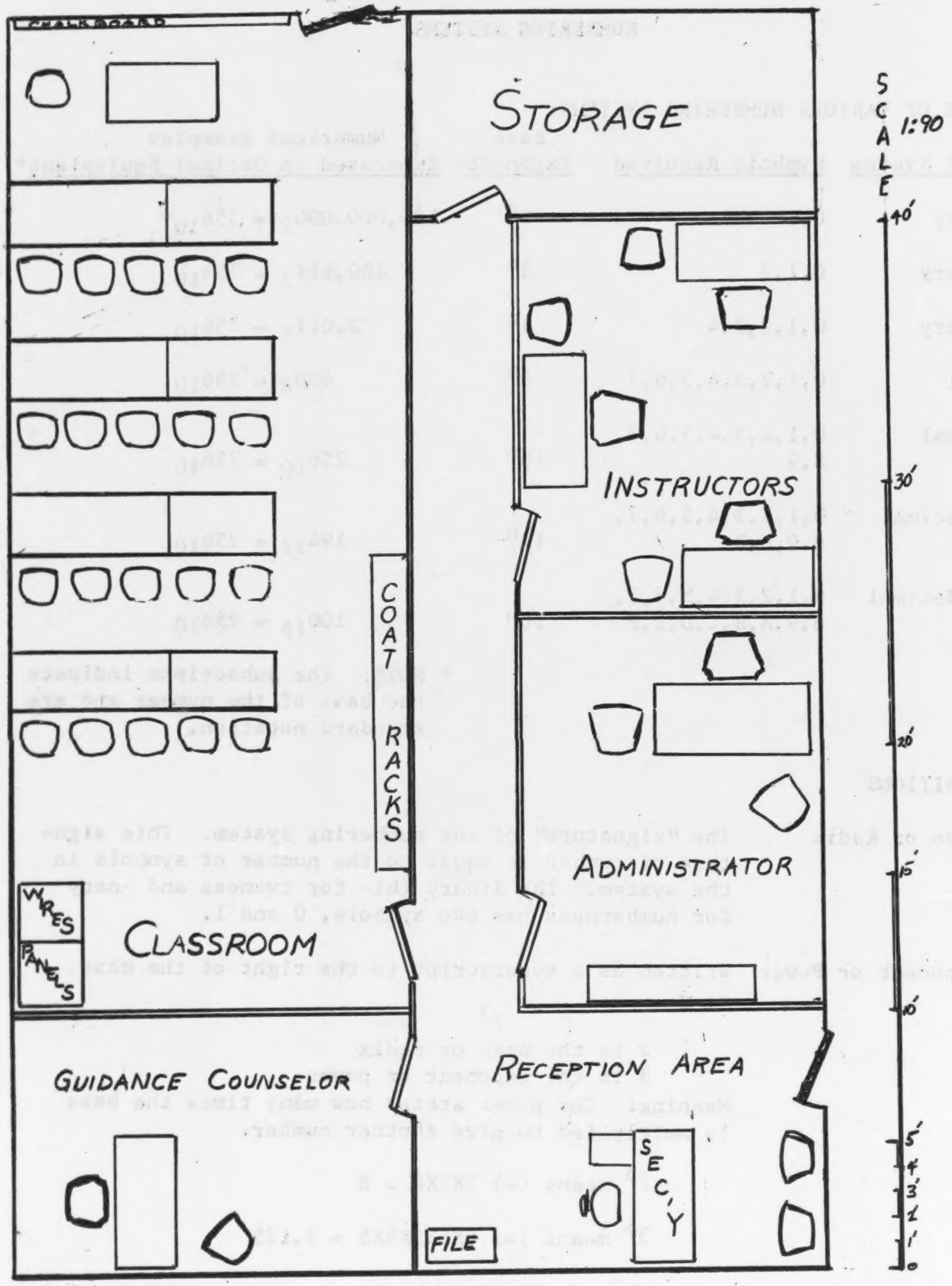
21	Stewart, Marie M., and others. Business English and Communication.
21	Rice, Louis A., and others. Business Mathematics for Colleges.
21	Hayden, Dunstan. Algebra One.
15	Mayor, John R. Contemporary Algebra, Second Course.

C. Optional Supplies

21	Bux, William A.	Key-Punch Training Course and Kit.
21	Bux, William A.	Sorter and Tabulator Training Kit.

Appendix B

SUGGESTED TRAINING FACILITY


CHALKBOARD
STORAGE
SCALE 1:90
40'
30'
20'
15'
10'
5'
4'
3'
2'
1'
0
INSTRUCTORS
COAT RACKS
ADMINISTRATOR
WIRES
PANELS
CLASSROOM
GUIDANCE COUNSELOR
RECEPTION AREA
SEC'Y
FILE

Appendix C

SAMPLE HANDOUTS

NUMBERING SYSTEMS

A TABLE OF VARIOUS NUMBERING SYSTEMS:

Name of System	Symbols Required	Base Exponent	Numerical Examples Expressed in Decimal Equivalent*
Binary	0,1	2^n	$100{,}000{,}000_2$* $=$ 256_{10}*
Ternary	0,1,2	3^n	$100{,}111_3 = 256_{10}$
Quinary	0,1,2,3,4	5^n	$2{,}011_5 = 256_{10}$
Octal	0,1,2,3,4,5,6,7	8^n	$400_8 = 256_{10}$
Decimal	0,1,2,3,4,5.6,7, 8,9	10^n	$256_{10} = 256_{10}$
Duodecimal	0,1,2,3,4,5,6,7, 8,9,A,B	12^n	$194_{12} = 256_{10}$
Hexadecimal	0,1,2,3,4,5,6,7, 8,9,A,B,C,D,E,F	16^n	$100_{16} = 256_{10}$

* NOTE: The subscripts indicate the base of the number and are standard notation.

DEFINITIONS

Base or Radix	The "signature" of the numbering system. This signture of number is equal to the number of symbols in the system. The Binary (bi- for twoness and -nary for numberness has two symbols, 0 and 1.
Exponent or Power	Written as a superscript to the right of the base, e. g.,

$$2^3$$

2 is the base or radix
3 is the exponent or power

Meaning: The power states how many times the base is multiplied to give another number.

2^3 means (=) 2X2X2 = 8

5^5 means)=) 5X5X5X5X5 = 3,125

THE 14 WORDS THAT MAKE ALL THE DIFFERENCE

from Coronet Magazine, August 1956

Learn the breakdown of these 14 basic words, says an expert, and you will hold the master key to a supervocabulary of 100,000 words.

Your success in business, trade, profession--even in love and marriage--may depend on the number of words you know. New research has found that there's a definite correlation between success and good vocabulary.

The more words you know, the more likely you are to understand what you hear or read. Also, when you speak or write, you have a better chance of being understood.

When a member of the Florida Board of Health gave 100 pregnant women a simple vocabulary test, the results were frightening.

One woman didn't even know what the word pregnancy meant. Several thought that maternity only referred to the clothes pregnant women wear. Such misunderstanding, or lack of words in a mother's vocabulary could easily lead to trouble that might affect her own and her child's health.

The building of a good vocabulary has generally been accomplished by painstakingly memorizing the meanings of one word after another. But there is a better and easier way.

Most English word meanings are formed by a comparatively few syllables repeated again and again throughout the language. And some ten years ago, Dr. James I. Brown of the University of Minnesota, a leading authority on vocabulary, set out to discover which of these syllables were most important in the teaching of vocabulary.

He broke down every word in Webster's Collegiate Dictionary and tabulated the prefixes (the first syllables of words) and roots (the syllables containing the basic meanings) in the order of their importance. The most important are found in what he calls the 14 Master Words in the center column of the chart.

If used as directed for as little as 15 minutes a day for two weeks, this chart can serve as a key for reasoning out the meaning of an estimated 100,000 words.

This chart breaks the 14 Master Words apart, with the prefixes printed on the left and the roots on the right. Each prefix and root has its own meaning.

Learn the prefixes and roots, how they are used and how to recognize them as they appear in different words. Work with one word at a time.

Here are the steps to take with each word:

1. Look it up in a dictionary. When you know the correct definition, jot down the word in a sentence. For example, with the first word you might write: "I will detain the man."

2. Now notice how the meanings of the prefix and root have been combined to make the total meaning of the word. In detain, de means "down", and tain means "to hold". If you detain a man, you literally "hold" him "down".

3. Look up all the other words in the dictionary beginning with the same prefix and notice how its meaning has been applied.

4. Several prefixes have different spellings. Look through the dictionary for words beginning with these spellings and notice how the root's meaning applies to the words' total meanings.

5. Now turn your attention to the root. See what other words you can think of or find in the dictionary using it. Notice how the root's meaning applies to the words' total meanings.

   For example, take the third word's root, cept. To accept something is to "take" something.

   Now try the different spellings of the root. Cap, for instance, is found in "capable". A capable leader "takes" leadership.

6. After a few days, try constructing words by applying different roots. For example, take the second prefix, inter. Add it to the fourth root, fer. You will see how interfere was born.

Use these six steps, working your way a day at a time down the list. As you progress, the exercises become harder. The last few words, for example, have two prefixes each. Also, the prefix in appears twice with two different meanings. The correct meaning, however, becomes obvious when you notice how a word with the prefix in is used in a sentence.

If you want a dramatic example of how often the prefixes and roots appear, take a printed page and find all the prefixes and roots from the chart that you can. If you do a good job, you will literally change the page's color.

KEY TO 100,000 WORDS

	Prefix	Its Other Spellings	Its Meaning	Master Words	Root	Its Other Spellings	Its Meaning
1.	DE-	-	Down or Away	DETAIN	TAIN	Ten, Tin	To Have or Hold
2.	INTER-	-	Between	INTERMITTENT	MITT	Miss, Mis Mit	To Send
3.	PRE-	-	Before	PRECEPT	CEPT	Cap, Capt, Ceiv, Ceit, Cip	To Take or Seize
4.	OB-	Oc-Of-Op-	To, Toward, Against	OFFER	FER	Lat, Lay	To Bear or Carry
5.	IN-	Il-Im-Ir-	Into	INSIST	SIST	Sta	To Stand, Endure, or Persist
6.	MONO-	-	One or Alone	MONOGRAPH	GRAPH	-	To Write
7.	EPI-	-	Over, Upon or Beside	EPILOGUE	LOG	Ology	Speech or Science
8.	AD-	A-Ac-Ag- Al-An-Ap- Ar-As-At-	To or Towards	ASPECT	SPECT	Spec, Spi, Spy	To Look
9.	UN-	-		UNCOMPLICATED	PLIC	Play, Plex. Ploy, Ply	To Fold, Bend, Twist or Interweave
	COM-	Co- Col- Con- Cor-	With or Together				
10.	NON-	-	Not	NONEXTENDED	TEND	Tens, Tent	To Stretch
	EX-	E- Ef-	Out or Formerly				

	Prefix	Its Other Spellings	Its Meaning	Master Words	Root	Its other Spellings	Its Meaning
11.	RE-	-	Back or Again	REPRODUCTION	DUCT	Duc, Duit Duk	To Lead, Make, Shape or Fashion
	PRO-	-	Forward or In Favor of				
12.	IN-	Il-Im-Ir-	Not	INDISPOSED	POS	Pound Pon, Post	To put or Place
	DIS-	Di- Dif-	Apart from				
13.	OVER-	-	Above	OVERSUFFICIENT	FIC	Fac, Fact, Fash, Feat	To Make or Do
	SUB-	Suc-Suf- Sug-Sup- Sur-Sus-	Under				
14.	MIS-	-	Wrong or Wrongly	MISTRANSCRIBE	SCRIBE	Scrip, Scriv	To Write
	TRANS-	Tra-Tran-	Across or Beyond				

Appendix D

FORMS AND RECORDS

TRAINEE INFORMATION FORM

GENERAL

Name ________________________________ Date of Birth __________
Home Address ______________________________ Zip __________
Male or Female __________ Home Telephone ________________

EDUCATION

High School Attended ______________________ Graduate ______
Did you attend College ______ How Long __________ Graduate ______
Name and address of College ______________________________
____
What was your favorite subject in H. S. or College ______________
What subject did you like least ______________________________

MILITARY EXPERIENCE (For Male Applicants Only)

Draft Status __________ Member of Reserve Unit ____ or National Guard ____
Were you ever in the Service ______ Which Branch ______________
How long ________ Job Specialty in Service ______________________

WORK EXPERIENCE

Name and address of present or latest employer __________________
____
Type of work performed ____________________________________
What did you like most about this job ___________________________
What did you like least about this job ___________________________
How long on this job ______ Reason left __________________________
How many jobs have you had since leaving High School __________

PERSONAL

(Circle one) Single Married Divorced Separated Widowed
Ages of Children, if any ____________________________________
Does wife (husband) work ______ Hour of work ____________________

Do you certify that your health is such as to enable you to faithfully attend classes daily (8 hours per day) Mondy through Friday, and that you know of no other reason that would prevent your attendance?

(Signed) ______________________________________

EMPLOYER REFERRAL RECORD

Employer Name

Employer Address

Contact Phone

REFERRALS AND DATES

Trainee Date

Result

Trainee Date

Result

Trainee Date

Result

Trainee Date

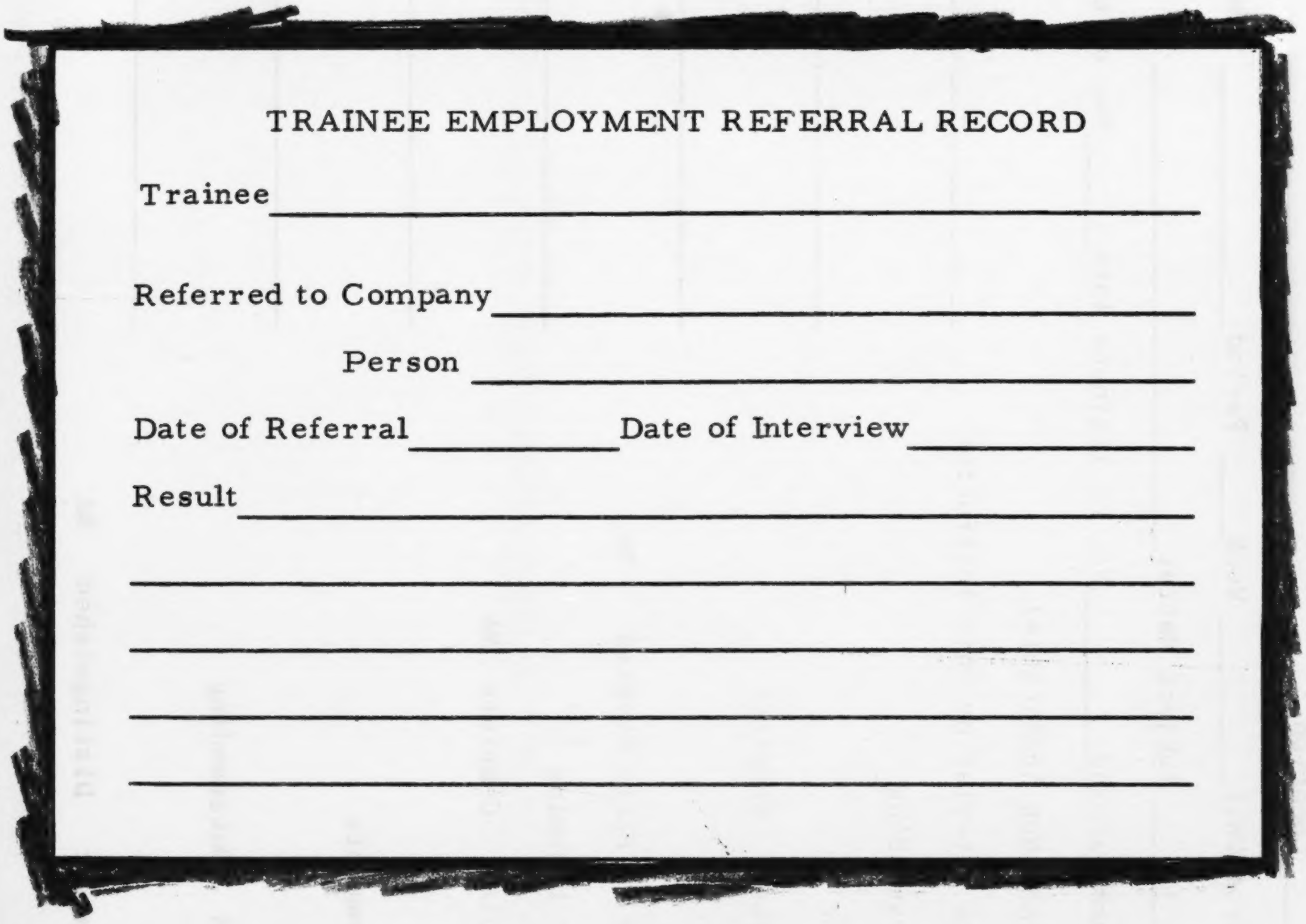
Result

Trainee Date

Result

Trainee Date

Result



TRAINEE EMPLOYMENT REFERRAL RECORD

Trainee ____

Referred to Company ______________________________

Person ______________________________

Date of Referral __________ Date of Interview ______________

Result ____

____

____

____

____

EVALUATION OF INSTRUCTION REPORT

Date____________ Class ____________ Location________________________

Lecture ( )
Discussion ( )
Audio-visual ( )
Laboratory ( )

Instructor__________________ Course Unit________ Week____ Period____________

Senior Instructor____________________ Subject Matter____________________

No. of Trainees Absent_______No. of them excused________No. of Trainees late_____No. of them excused___

Circle the appropriate evaluation (NA means Not Applicable)

1. Motivation of the trainees toward the material by this Instructor ____________________

   None Weak Good Excellent Outstanding

2. Technical knowledge of the Instructor ____________________

   Inadequate Limited Adequate Broad Complete

3. Following of Curriculum Outline ____________________

   No Partial Largely Definitely Fully Covered NA

4. Checking the Status of the Trainees' Learning ____________________

   Omitted Slight Occasional Regular Complete NA

5. Control of Class ____________________

   None Slight Passable Normal Complete

6. Appearance of the Instructor ____________________

   Poor Acceptable Neat Very Good Outstanding

7. Speaking Presentation ____________________

   Poor Mediocre Acceptable Competent Distinguished NA

8. Use of Training Aids ______________________

Not Used   Poorly Used   Adequately Used   Well Planned   Perfectly Coordinated   NA

9. Discussion or Question and Answer Period ______________________

None   Very Short   Normal   Very Good   Superior   NA

10. Skill in Explaining and Demonstrating ______________________

Poor   Moderate   Good   Accomplished   Superior   NA

11. Review of Previous Material ______________________

Omitted   Slight   Incomplete   Complete   Exceptional   NA

12. Introduction of New Material ______________________

Poor   Inadequate   Adequate   Competent   Exceptional   NA

13. Summation ______________________

Poor   Inadequate   Adequate   Competent   Exceptional   NA

14. Direction of Problem Solving ______________________

Poor   Moderate   Good   Accomplished   Outstanding   NA

COMMENTS: Please comment on any of points 1 through 14 where a substandard (1st two choices) evaluation was given, suggest methods of improvement, give any other comments you wish. Use an attachment if neede

Signature of Monitor______________________ Title______________________

DESCRIMINATION PROHIBITED

Title VI of the Civil Rights Act of 1964 states: "No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subject to discrimination under any program or activity receiving Federal financial assistance." Therefore, the Manpower Development and Training Program, like every program or activity receiving financial assistance from the Department of Health, Education, and Welfare, must be operated in compliance with this law.